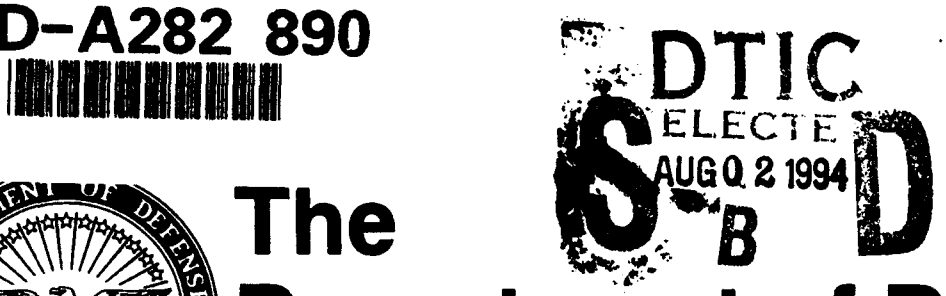


The Department of Defense

DoD DEPARTMENTS/AGENCIES:

Department of the Army

Department of the Navy

Department of the Air Force

ARPA Advanced Research Projects Agency

Defense Nuclear Agency

BMDO Ballistic Missile Defense Organization

Special Operations Command

SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

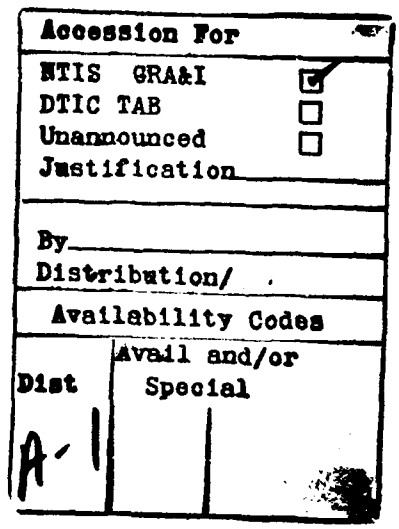
FY 1993 SBIR SOLICITATION

PHASE I AWARD ABSTRACTS

AIR FORCE PROJECTS

VOLUME III

TABLE OF CONTENTS



(3) (413)

PREFACE

This report presents the technical abstracts of the Phase I proposals that resulted in contract awards during Fiscal Year 1993 from solicitations of the Department of Defense (DoD) Small Business Innovation Research (SBIR) Program. The Army, Navy, Air Force, Advanced Research Projects Agency (DARPA), Defense Nuclear Agency (DNA), Ballistic Missile Defense Organization (BMDO, formerly SDIO), and Special Operations Command (SOCOM) are the DoD components of the SBIR Program. Two solicitations inviting small business firms to submit proposals under this program were published in FY93. Army, Navy, Air Force, ARPA, DNA, and BMDO participated in Program Solicitation 93.1 (Closing Date: 15 January 1993), and Army, Navy, ARPA and SOCOM participated in Program Solicitation 93.2 (Closing Date: 2 August 1993). The selection of proposals for funding was made from proposals received by the Military Services and Agencies.

FY 1993 SBIR PROGRAM

	Number of Topics		Proposals Received		Phase I Awards			
	93.1	93.2	93.1	93.2	91	92	93.1	93.2
Army	36	309	498	2,840	--	246	42	--
Navy	132	145	1,624	1,102	20	84	187	9
Air Force	188	--	2,996	--	--	4	466	--
ARPA	32	87	407	817	--	--	58	--
DNA	20	--	190	--	--	--	19	--
BMDO	16	--	767	--	--	--	147	--
SOCOM	--	3	--	37	--	--	--	3
Total	424	544	6,482	4,796	20	334	919	12
Grand Total	968		11,278		1,285			

As of the FY93 Annual Report (dated 15 March 1994), most of the FY93.2 proposals were selected but not yet awarded. The figures above show a quarter of the Phase I awards made in FY93 came from the FY91 and FY92 solicitations. Of the 1,285 Phase I awards made in FY93, 258 awards (approximately 20 percent) went to minority-owned or woman-owned businesses.

In order to make information available on the technical content of the Phase I projects supported by the DoD SBIR Program, four volumes containing the abstracts and contracts for the awarded projects are published. The small business information with accompanying abstract are arranged in alphabetical order by firm name. Cross reference indices appear at the back of the volume for quick reference.

- Volume I contains Army Projects
- Volume II contains Navy Projects
- Volume III contains Air Force Projects
- Volume IV contains ARPA, DNA, BMDO, and SOCOM Projects

Venture capital and large industrial firms that may have an interest in the research described in the abstracts in this publication are encouraged to contact the firm whose name and address is shown.

(5) '613

INTRODUCTION

In 1982, Congress enacted and the President signed the "Small Business Innovation Development Act of 1982" (Public Law 97-219), which created the Small Business Innovation Research (SBIR) Program to give small, high-technology firms a greater share of the federally-funded research and development contract awards.

Under the SBIR Program, each federal agency with an extramural budget for research or research and development in excess of $100 million per fiscal year must establish an SBIR Program. The program is currently funded by setting aside 1.5 percent of the participating agency's extramural R&R&D contracting dollars. The agencies participating in the Department of Defense SBIR Program are the Army, Navy, Air Force, Advanced Research Projects Agency (ARPA), Defense Nuclear Agency (DNA), Ballistic Missile Defense Organization (BMDO, formerly SDIO), and Special Operations Command (SOCOM).

The objectives of the DoD SBIR Program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting DoD research and development needs, encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development.

The SBIR Program consists of three distinct phases. Under Phase I, DoD components make awards to small businesses, typically of up to one man-year of effort over a period of six months, subject to negotiation. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas or concepts submitted in response to SBIR topics. Proposals selected for contract award are those which contain an approach or idea that holds promise to provide an answer to the specific problem addressed in the topic. Successful completion of Phase I is a pre-requisite for further DoD support in Phase II.

Phase II awards will be made only to firms on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. Proposals which identify a follow-on Phase III funding commitment will be given special consideration. Phase II awards will typically cover two to five man-years of effort over a period of 24 months, also subject to negotiation. The number of Phase II awards will depend upon the success rate of the Phase I effort and availability of funds. Phase II is the principal research or research and development effort, and requires a comprehensive proposal outlining the intended effort in detail.

In Phase III, an innovation is brought to the marketplace by private sector investment and support. No SBIR funds may be used in Phase III. Also, under Phase III, DoD may award follow-on contracts with non-SBIR funds for products and processes meeting DoD mission needs.

Proposals received in response to a DoD solicitation are evaluated on a competitive basis in the organization which generated the topic, by scientists and engineers knowledgeable in that area. Selections for Phase I are made in accordance with the following criteria:

- The soundness and technical merit of the proposed approach and its incremental progress toward topic or subtopic solution.
- The potential for commercial (government or private sector) application and the benefits expected to accrue from this commercialization.
- The adequacy of the proposed effort for the fulfillment of requirements of the research topic.
- The qualifications of the proposed principal/key investigators, supporting staff and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.

The "Small Business Innovation Act of 1986" (P.L.97-443) extended the "Sunset Clause" to 1993 and increased the taxation of the extramural research and development budget to 1.25 percent. The latest SBIR re-authorization law (P.L. 102-564), signed October 28, 1992, extends the program through 2000, doubles the taxation to 2.5 percent by 1997, and increases the average Phase I and Phase II award agreements.

(7) SB

ABTECH CORP.
508 DALE AVENUE
CHARLOTTESVILLE, VA 22903
Phone: (804) 977-0686
Topic#: 93-108 ID#: 93WL2-019
Office: WL2
Contract #: F33615-93-C-1239
PI: Keith Drake
Title: An Ontogenic Polynomial Neural Network/Expert System Modeling Environment for Chaotic Avionics Systems Behavior Prediction
Abstract: Ontogenic neural networks, those which automatically discover their topology during synthesis, offer substantial advantages over traditional machine learning techniques. They also have the potential to offer many benefits in several areas of avionics research. Among potential application areas is the ability to predict or forecast the behavior of a seemingly random or chaotic system. This proposal presents an existing ontogenic neural network paradigm - polynomial networks - and discusses both substantial enhancements to its learning algorithm and the development of an evolutionary modeling environment. This will be achieved by implementing system modeling strategies in a production-rule environment using the CLIPS expert system tool. This proposal also discusses a feasibility demonstration for a specific avionics application to clearly demonstrate the utility of the ontogenic paradigm. During Phase I, AbTech will design major enhancements to the existing ontogenic neural network paradigm, implement and deliver a substantial subset of these enhancements, and demonstrate the results of applying the resulting Phase I learning system to a well-defined avionics application. During Phase II, AbTech will implement the full Phase I design and apply the resulting modeling environment to an operational solution of the chaotic avionics system behavior prediction application.

ACCURATE AUTOMATION CORP.
7001 SHALLOWFORD ROAD
CHATTANOOGA, TN 37421
Phone: (615) 894-4646
Topic#: 93-073 ID#: 93PL1-919
Office: PL1
Contract #: F29601-93-C-0042
PI: Michael Lothers
Title: Sensor Fusion in a Dynamic Model-based System
Abstract: An approach to object identification and sensor fusion of images is proposed. Preprocessing techniques which perform a useful and computationally efficient transformation on the image will be considered. Once the image has been transformed to a more efficient format, mathematical morphology and neural networks are proposed to address the issues of edge detection, identification, sensor fusion and model generation from various types of sensor data. After models are generated from each sensor, a weighted average (based upon the accuracy and performance of each sensor) can determine a new or refined object model. The cooperative-competitive neural network will be used to identify the model as a particular class of object.

ACCURATE AUTOMATION CORP.
7001 SHALLOWFORD ROAD
CHATTANOOGA, TN 37421
Phone: (615) 894-4646
Topic#: 93-108 ID#: 93WL2-023
Office: WL2
Contract #: F33615-93-C-1240
PI: Kevin Priddy, Ph.D.
Title: Ontogenic Neural Networks for Avionics Applications
Abstract: The study of neural networks which possess the capability to learn and grow with little or no supervision will be explored during this research effort. These networks exhibit ontogenic behavior and are termed ontogenic neural networks. This research effort explores the use of hybrid neural network structures which are capable of self-organization, feature discovery and self generation in a composite architecture which is capable of solving pattern recognition tasks. These networks will be examined for suitability in automatic target recognition, threat assessment, route planning or another problem selected by the Air Force and Accurate Automation. The ontogenic neural network developed in this effort will be thoroughly examined for learning rate, generalization capability, classification accuracy, representation of higher order relationships, self-organization ability and hardware implementation.

ACCURATE AUTOMATION CORP.
7001 SHALLOWFORD ROAD
CHATTANOOGA, TN 37421
Phone: (615) 894-4646
Topic#: 93-184 ID#: 93WL9-034
Office: WL9
Contract #: F33657-93-C-2233
PI: Chadwick J. Cox
Title: Neural Network Methods for Preventing Unstarts

Abstract: We will use an innovative neural network algorithm to predict and control National Aero-Space Plane(NASP) unstarts at the earliest possible moment. Unstarts present a design challenge to hypersonic aircraft. An unstart occurs when the pressure at the aft end of the engine flow path reaches a critical level. This overpressure causes a "choking" of the air flow. The flow tends to spill around the inlet and the pressures in the flowpath become excessively high. The thrust goes to zero. These high pressures can damage the engine and if the design is not sufficiently robust, an unstart could lead to loss of the vehicle. By predicting the unstart at the earliest possible moment, the prediction algorithm will give the control algorithm enough time to prevent the unstart. A few extra milliseconds additional lead time could improve control. We will compare traditional methods of pattern recognition against a neural network approach to determine if critical time could be gained with the neural approach.

ACTIVE CONTROL EXPERTS, INC.
PO BOX 15195
BOSTON, MA 02215
Phone: (617) 576-3445
Topic#: 93-158 ID#: 93XRX-142
Office: XRX
Contract #: F33657 '3-C-2321
PI: Kenneth B. Lazarus, Ph.D.
Title: An Active Smart Material System for Buffet Load Alleviation
Abstract: The proposed effort investigates the use of smart materials (such as strain actuators and sensors) and modern control theory to suppress unsteady buffet loads encountered by vertical tail aircraft such as the F/A-18. The active smart material system proposed has distinct advantages over traditional passive damping treatments and active articulated control surface techniques. This innovative smart material approach has the potential to improve aircraft performance and reduce maintenance costs significantly. The technical objectives of the proposed project include: (1) defining the functional requirements for the active smart material system, (2) assembling an integrated aeroelastic/smart material model, (3) choosing the most appropriate controller architecture, and (4) designing and analyzing controllers for active smart material systems in order to suppress unwanted buffet loads. Essentially, the goal of the Phase I effort is to determine the effectiveness, in terms of performance achieved versus added weight, of an active smart material system for buffet load suppression. The program is targeted toward buffeting problems experienced by the F/A 18, but the innovation described in the proposal has application to other operational, as well as future, high performance vertical tail aircraft.

ADA TECHNOLOGIES, INC.
304 INVERNESS WAY SOUTH, SUITE 110
ENGLEWOOD, CO 80112
Phone: (303) 792-5615
Topic#: 93-011 ID#: 93AFC-058
Office: AFCESA
Contract #: FO8635-93-C-0107
PI: MICHAEL D. DURHAM
Title: Application of Pulse Corona Induces Plasmas for Control of NOx From Jet Engine Test Cells
Abstract: Jet engine test cells are faced with meeting regulations related to NOx emissions and opacity. Based upon reported research results, it appears that the Pulse Induced Plasma Chemical Process (PPCP) could be effectively applied to jet engine test cells for the control of NOx. The process provides high efficiency NOx removal at relatively low temperature without the need for NH3 injection. PPCP can be designed for a flow-through configuration which could be installed in a test cell with minimal pressure drop. In addition, VOCs present in the exhaust stream would be destroyed and particles would be collected by this system. The primary objective of the Phases I program is to determine the technical feasibility of developing PPCP for jet engine test cells. This requires the design and testing of components that can be incorporated into a control system that will fit the specific geometric constraints of size, flow rate, and pressure drop necessary for use in the existing test cells. The Phase I effort will involve a laboratory study to evaluate several key subsystems of the proposed technique and develop data required for designing a prototype full-scale test system.

ADA TECHNOLOGIES, INC.
304 INVERNESS WAY SOUTH, SUITE 110
ENGLEWOOD, CO 80112
Phone: (303) 792-5615
Topic#: 93-011 ID#: 93AFC-092
Office: AFCESA
Contract #: FO8635-93-C-0113
PI: MR JAMES BUTZ
Title: Fine Water Mist System for Replacement of Halon 1301 Fire Extinguisher Systems
Abstract: U.S. production of Halons will decrease from 28 million lbs in 1988 to zero in 1995 to meet the U.S. commitments to the Montreal Protocol. A major use of Halon 1301 is as a fire suppression flooding agent. The use of fine water mists from two-fluid atomizing nozzles is proposed as a replacement for Halon 1301 fire suppression systems, especially for Class B fuel

fires. The optimum droplet size and atomizer water flow rate will be determined in the Phase I research. Several candidate atomizers will be tested against a standard n-heptane fire in a test chamber. Spray droplet size and water application rates will be varied over a range determined by modeling of the evaporation rate of the droplets. Requirements for a fire suppression atomizer nozzle will be prepared, based on the test results. In Phase II, a prototype fire suppression system will be designed, built, and tested on typical Air Force Class B fires. A specification for fine water mist fire suppression systems to replace existing Halon 1301 systems will be based on these Phase II tests.

ADHERENT TECHNOLOGIES
9621 CAMINO DEL SOL NE
ALBUQUERQUE, NM 87111
Phone: (505) 822-9186
Topic#: 93-011 ID#: 93AFC-148
Office: AFCESA
Contract #: FO8635-93-C-0109
PI: RONALD E. ALLRED
Title: Recycling Process for Aircraft Plastics and Composites
Abstract: An effective process for recycling plastics and composites used in aircraft does not currently exist. As a result, scrap and used materials are disposed of in landfills. A chemical recycling process is proposed that will allow the components of these waste materials to be converted to valuable hydrocarbons, fillers and fibers that can then be reused or sold. The proposed chemical recycling process is a low-temperature, catalytic method that breaks polymers down into low molecular weight fractions of the starting prepolymer material. Fibers and fillers my be separated from the liquid hydrocarbons and reused in secondary applications. The hydrocarbons may be refined and used as chemicals, fuels, or polymer precursors. Initial feasibility studies have shown that the conversion process is applicable to a wide variety of commodity plastics. The proposed Phase I program is to determine the applicability of the conversion process to high-temperature polymers used as composite matrices including epoxies, bismaleimides, phenolics, and engineering thermoplastics and to identify the conversion products. These data will provide the basis for determining process economics and scale-up requirements.

ADTECH SYSTEMS RESEARCH, INC.
1342 N. FAIRFIELD ROAD
BEAVERCREEK, OH 45432
Phone: (513) 426-3329
Topic#: 93-153 ID#: 93WL6-173
Office: WL6
Contract #: F33615-93-C-2322
PI: JALEES AHMAD
Title: A Model for Predicting MMC Response Under Multiaxial Loading
Abstract: This proposal addresses the immediate need for models for accurate description of metal matrix composite (MMC) response to multiaxial loadings such as those existing in most turbine engine components. The model is needed for both design and life prediction of engine components. The proposed effort will result in a cost-effective method of predicting MMC response under multiaxial loading which will include the consideration of fiber-matrix debond and matrix inelasticity. However, the final model will be in a relatively simple form so that it can be readily incorporated into design and life prediction analysis software used by engine manufacturers. The technology resulting from the proposed research will be of immediate use to turbine engine manufacturers as well as airframe structure manufacturers using MMCs. But the model will provide an essential (and currently unavailable) input to design of MMC components for a wide variety of Defense as well as civil applications.

ADTECH SYSTEMS RESEARCH, INC.
1342 N. FAIRFIELD ROAD
BEAVERCREEK, OH 45432
Phone: (513) 426-3329
Topic#: 93-186 ID#: 93WL9-037
Office: WL9
Contract #: F33657-93-C-2234
PI: Jalees Ahmad
Title: Fracture Mechanics Based Life Prediction of High Temperature Composite Joints
Abstract: An important aspect in the design of aircraft structure and aeropropulsion components made of high temperature composite materials is damage tolerance and life prediction. Many components contain joints between composites and metals. There is a need to develop methods for predicting life of such components and then implementing the methods in software for design calculations on computers. The proposed research addresses this need. Specifically, Phase I has the objective of assessing the feasibility of a model formulated by AdTech to predict crack growth rates associated with fabrication or service induced cracks within joints. A combined mechanics of composites, interface fracture mechanics and experimental approach is proposed. Experiments will be performed using joints of a titanium matrix composite. If found feasible, Phase II will involve

data base generation, further validation and implementation of the model in a general design and life prediction methodology which may involve a probabilistic framework. The methodology will be implemented in a user friendly software package.

ADVANCED FUEL RESEARCH, INC.
P. O. BOX 380379
EAST HARTFORD, CT 06138
Phone: (203) 528-9806
Topic#: 93-155 ID#: 93WL6-120
Office: WL6
Contract #: F33615-93-C-2328
PI: MICHAEL SERIO

Title: An FT-IR Based Instrument for the Evaluation of Synthetic Lubricants

Abstract: A typical Air Force base will produce several thousand gallons per year of used turbine engine lubricants. These lubricants can be collected on site and sold at relatively low cost for other uses (e.g., plasticizer). The potential for contamination of the collected lubricants, particularly with halogenated compounds such as degreasing solvents or turbine fuels, reduces the effectiveness of a previously developed reclamation process. The innovation is the use of a novel thermal/Fourier Transform Infrared (FT-IR) analysis technique in combination with advanced data analysis methods to develop an on-site, user friendly, low cost, and reliable means of identifying contamination in used turbine engine lubricants. The overall objective of the proposed Phase I program is to demonstrate the feasibility of thermal analysis combined with a multi-mode FT-IR analysis of the gaseous products for identification of contamination of synthetic lubricants. This program would be divided into four specific tasks: 1) sample selection and preparation; 2) analysis studies in a multi-mode thermal/FT-IR instrument; 3) data analysis to determine detectability limits and quantitation of contaminants; and 4) assessment of requirements for prototype instrument that would be built and tested under the Phase II program. The use of neural network analysis to identify the contaminants of interest would be investigated in Phase I and fully developed in Phase II.

ADVANCED MATERIAL SYSTEMS, INC.
230, WEST HALL, SUITE 201
SLIDELL, LA 70460
Phone: (504) 649-5536
Topic#: 93-177 ID#: 93WL0-194
Office: WL0
Contract #: F08630-93-C-0068
PI: MATTHEW T. LIU

Title: Replacement Materials for Chromates in Coatings and Sealants

Abstract: Use of chromates as corrosion inhibitors in coatings, adhesives and sealants is a well established technology. However, toxicity and waste disposal problems have led to the urgent need for development of an environmentally benign substitute for chromium compounds in coatings and sealants, which is the subject of this SBIR. This paper discusses the state-of-the-art technical approaches to the solution and suggests: (1) Grafting of metal surface with "surface active agent", such as quaternary chelating agents and gianidines to passivate potentially active corrosion sites on the metal surface. (2) Converting the metal oxide layer, which is formed as a corrosion product on the metal surface, into a protective layer for the surface beneath. The paper also discusses material selection criteria, formulation hypotheses, and proof of concept testing for the development of a non-toxic and environmentally safe inhibitors to be used in chemical conversion coating of aluminum and aluminum alloy (MIL-C-5541), primer coating of metals (M1L-P-23377), and corrosion inhibiting sealing compounds (M1L-8-81733). Future development efforts, as well as developmental directions in optimizing corrosion resistant properties, are suggested.

ADVANCED PROJECTS RESEARCH, INC.
5301-A NORTH COMMERCE AVENUE
MOORPARK, CA 93021
Phone: (805) 523-2585
Topic#: 93-158 ID#: 93XRX-054
Office: XRX
Contract #: F33657-93-C-2322
PI: Joseph W. Humphrey

Title: A Variable Thurst Detonation Wave Engine, DWE, for Mach 0 to 3 Applications

Abstract: This proposal describes a novel, high thrust density Detonation Wave Engine (DWE) applicable to the Mach range of 0 to 3. The geometry of this novel engine concept naturally provides for integration into a new Combined Cycle Engine with Ramjets. The concept is an intermittent combustion jet engine that harnesses traveling detonation waves to accomplish compression and chemical reaction. The goal is to obtain an engine which operates in the Mach 0 to 3 range, integrates well with Ramjets to form a high performance combined Cycle Engine, and has low weight penalty. The Detonation Wave Engine through the controlled use of the strong gas dynamic waves can be configured to provide both engine aspiration (i.e. static thrust) and relatively high charge compression. These result in several potential benefits from DWE's including 1) high thrust density, 2) high specific impulse, 3) significant static thrust, 4) natural geometry for integration into a Combined Cycle Engine, and 5)

(12)

low cost. This project will in Phase I develop the cycle analysis tools for analyzing this unsteady combustion device complete with finite rate chemistry, determine essential engine configuration, provide the necessary tool to design tools to determine a Proof of Concept demonstration, and define the Proof of Concept demonstration to show performance and feasibility. Phase II will conduct the Proof of Concept demonstration.

ADVANCED PROJECTS RESEARCH, INC.
147 WARD STREET
HIGHTSTOWN, NJ 08520
Phone: (609) 443-4986
Topic#: 93-164 ID#: 93WL0-054
Office: WL0
Contract #: F08630-93-C-0021
PI: Thomas H. Sobota, PhD

Title: The Design of Sub-caliber Aero-thermal-chemical (ATC) Gun Projectiles for Aerodynamic Stability

Abstract: The following proposal details an effort required for understanding the in-bore aerodynamic stability of sub-caliber projectiles in aero-thermal-chemical (ATC) guns in order to design stable projectiles. The ATC gun is based on the concept of a projectile traveling through the propellant and deriving acceleration from the expansion of gases on the aft end of the projectile. Since the projectile must travel through the propellant, the projectile is generally sub-caliber so that the propellant can flow around it. One of the most important unanswered questions in Ram- and Scram-accelerator technology relates to the in-bore aerodynamic stability of the projectiles. If the stability of these sub-caliber projectiles was understood several important design problems for ram-accelerator systems could be greatly simplified. In the proposed Phase I effort, the in-bore aerodynamic stability of ram-accelerator projectiles will be examined. A three-dimensional computational fluid dynamics (CFD) code will be used to assess the static stability of the projectile, the effect of several shape parameters on stability will be explored and a linearized analysis for the dynamic stability will be performed. The results of the Phase I effort will demonstrate the usefulness of CFD as a stability analysis tool and lay the groundwork for the study of the dynamic stability in Phase II.

ADVANCED PROJECTS RESEARCH, INC.
5301-A NORTH COMMERCE AVENUE
MOORPARK, CA 93021
Phone: (805) 523-2585
Topic#: 93-184 ID#: 93WL9-018
Office: WL9
Contract #: F33657-93-C-2240
PI: Joseph W. Humphrey

Title: Hy-Scram: An Oblique Detonation Wave Hypervelocity Scramjet Engine

Abstract: The Oblique Detonation Wave Hypervelocity Scramjet (ODW Hy-Scram) Engine is applicable to hypersonic flight vehicles that require high Mach Scramjet operation. This project will implement a unique new analysis capability to analyze and assess a novel propulsion device that could greatly enhance applications in the hypersonic class of flight vehicles. The ODW Hy-Scram Engine is configured to use gas dynamic wave interactions to provide inlet stream primary compression (after vehicle forebody compression), bulk ignition, and rapid combustion. The major advantages over previous Scramjet engines are: 1) use of the vehicle forebody for fuel injection and complete mixing (due to longer distances, lower temperatures and lower pressures than is typical in the inlet fuel injection systems of Scramjet Engines); 2) simpler and shorter inlet design due to lower Mach range through which the flow must be decelerated (typically incorporated into the vehicle forebody), and 3) shorter and simpler combustor design. The primary benefit of this approach is the reduction of the weight associated with the propulsion system for a given combustion efficiency. The secondary benefit is stabilized combustion due to the bulk ignition of the fuel and oxidizer in the stable over driving of the oblique detonation wave.

ADVANCED REFRACTORY TECHNOLOGIES, INC.
699 HERTEL AVENUE
BUFFALO, NY 14207
Phone: (716) 875-4091
Topic#: 93-072 ID#: 93PL1-132
Office: PL1
Contract #: F29601-93-C-0160
PI: DR. V. F. DORFMAN

Title: Diamond-like Atomic-scale Composite Protective Coatings for Plasma and Micro-wave Devices

Abstract: Diamond-like multinetwork and network-crystalline atomic-scale composite coatings constitute a new class of materials with unique properties including high adhesion to virtually any substrate (including materials, crystalline and glass dielectrics, plastics), excellent thermal and diffusion barrier properties, good hardness, high elasticity and flexibility, very high thermal shock resistance, extremely low friction coefficient, controllable electrical properties, controllable refractive index, and good thermal stability especially in oxygen free environments. Films are deposited at low temperature (300-500K), and substrate size is limited only by chamber diameter (currently a 760mm diameter substrate can be coated). Coatings represent a significant

advance over conventional diamond-like films in allowing the ability to tailor properties. A range of coating materials can be produced for potential use in a wide variety of applications. The requirement for protective and insulating devices for microwave and plasma equipment may fall well within the characteristics of these materials. The fundamental structure of these atomic-scale composites is comprised of two self-stabilized random networks, each stabilized chemically by additional atomic species. An example of such structures is diamond-like nanocomposites (DLN) containing a C:H and Si:O networks. During Phase I, diamond-like carbon, DLN and doped-DLN coatings will be prepared on a selected substrate, and performance compared with the existing data on DLN and DLC. Properties of the most promising material will then be optimized and its dielectric, ablation, temperature resistance and ionization behavior studied under simulator plasma device conditions to evaluate longevity.

ADVANCED TECHNOLOGY MATERIALS, INC.
7 COMMERCE DRIVE
DANBURY, CT 06810
Phone: (203) 794-1100
Topic#: 93-044
Office: ES3
Contract #: F19628-93-C-0101
PI: Duncan W. Brown
ID#: 93ES3-043
Title: Arsine Abatement
Abstract: The continued use of arsine gas and/or its derivatives is vital to the manufacture of a wide variety of semi-conductor devices. While the use of arsine is growing, it poses serious environmental and safety problems in the industry. New methods must be found that permit the facile trapping and detoxification of arsine and its derivatives. Advanced Technology Materials, Inc. (ATM) has gained a reputation for the development of novel inorganic scavenger based systems for semi-conductor gas effluent treatment. It has designed and been granted patents for novel materials that treat metallization, etchant, and hydride gases commonly used in electronic thin film deposition. This chemical expertise has been combined with the equipment design expertise of Novapure Corporation to provide the industry with an alternative and cost effective approach to semi-conductor gas effluent treatment. In Phase I, ATM expects to both complete a survey of all possible methods of arsine detoxification, and to also determine the feasibility of a unique solid-phase scrubbing concept for the chemisorption and eventual detoxification of arsine. In Phase II, ATM, with Novapure Corporation, will supply a minimum of 3 Air Force-designated reactors with complete arsine effluent systems for B-site evaluation.

ADVANCED TECHNOLOGY MATERIALS, INC.
7 COMMERCE DRIVE
DANBURY, CT 06810
Phone: (203) 794-1100
Topic#: 93-082
Office: PL1
Contract #: F29601-93-C-0067
PI: DR. STEVE BILODEAU
ID#: 93PL1-303
Title: Electro-optic PLZT Films for Monolithic Tunable Band-pass Filters
Abstract: Electrically tunable optical filters have been identified as a critical element in many applications, including imaging and automated target recognition applications. While large electro-optic effects can be engineered in composite structures such as multiple quantum-wells or liquid crystals, SLMs based on ceramic materials in the PbLaZrTiO3 (PLZT) family of compounds show a unique combination of high transparency and large electro-optic effects. However, integration of PLZT ceramics in interference coating designs has been a major obstacle to the commercial acceptance of this approach. ATM has pioneered the use of chemical vapor deposition (CVD) to deposit complex oxide films and we now believe that a significant opportunity exists to utilize CVD to deposit films of PLZT on glass, allowing its integration in tunable band-pass filters. In Phase I, we will deposit thick PLZT films, the electro-optic properties will be optimized and a novel multi-element tunable band-pass filter will be fabricated. In Phase II, we will scale the process to an 8" single wafer commercial CVD system used at ATM for deposition of BaSrTiO3 films for DRAMs and pyroelectric IR detectors, and the deposition process will be optimized for high uniformity PLZT layers needed for 3" diameter tunable band-pass filters.

ADVANCED TECHNOLOGY MATERIALS, INC.
7 COMMERCE DRIVE
DANBURY, CT 06810
Phone: (203) 794-1100
Topic#: 93-141
Office: WL5
Contract #: F33615-93-C-5344
PI: Woo Sik Yoo
ID#: 93WL5-258
Title: Cubic Silicon Carbide Substrates
Abstract: Silicon carbide promises near-term insertion in high power, high temperature, applications. The wide band-gap and consequent high breakdown field of silicon carbide theoretically allows efficient high power solid state power amplifiers. Its

16

high thermal conductivity will permit compact devices and high power density. To date, virtually all silicon carbide-based devices have been fabricated using 6H-SiC; recent advances in bulk and epitaxial 6H-SiC crystal growth have increased its availability. However, 6H-SiC may not be the preferred polytype. The performance of high power and high frequency devices would significantly increase if 3C-SiC, the cubic form, were available. 3C-SiC has twice the electron and hole mobilities of 6H-SiC and has a slightly higher saturation electron drift velocity. In Phase I the feasibility of 3C-SiC substrate growth will be demonstrated with an innovative sublimation crucible design. The objective for Phase II is to optimize the growth of 3C-SiC substrates for device demonstrations. In Phase III, ATM and its partners will scale the crystal growth process to enable the manufacture of specific devices and to supply substrates in order to accelerate the growth of an SiC-based semi-conductor industry.

ADVANCED TECHNOLOGY MATERIALS, INC.
7 COMMERCE DRIVE
DANBURY, CT 06810
Phone: (920) 374-1100
Topic#: 93-168 ID#: 93WL0-114
Office: WL0
Contract #: F08630-93-C-0036
PI: Daniel P. Sharkey
Title: Thick PLZT films for Integrated Spatial Light Modulators
Abstract: Over the past twenty years two-dimensional spatial light modulators (SLM's) have been identified as a critical element in many applications. While large electro-optic effects can be engineered in composite structures such as multiple quantum-wells or liquid crystals, SLM's based on ceramic materials in the PbLaZrTiO3 (PLZT) family of compounds show a unique combination of high transparency and large electro-optic effects. However, integration of PLZT ceramics with associated electronics in SLM's is a major obstacle to their commercial acceptance. ATM has pioneered the use of chemical vapor deposition (CVD) to deposit complex oxide films, and we now believe that a significant opportunity exists to utilize CVD to deposit films of PLZT on silicon, allowing integration of the SLM with silicon-based drive electronics. In Phase I we will use this technique to deposit thick films (=10m) of PLZT and the films' electro-optic properties will be optimized. In Phase II we will scale the CVD process to an 8" single wafer commercial CVD system now in use at ATM for deposition of BaSrTiO3 films for DRAMs and pyroelectric IR detectors. The effort will culminate in a commercially available "turn-key" CVD process to fabricate thick, high quality PLZT films for integrated electro-optics.

AEROMETRICS, INC.
550 DEL REY AVENUE
SUNNYVALE, CA 94086
Phone: (408) 738-6688
Topic#: 93-001 ID#: 93AED-018
Office: AEDC
Contract #: F40600-93-C-0001
PI: William D. Bachalo
Title: Characterization of Simulated Weather Environments in Aerospace Ground Test Cells.
Abstract: Degraded performance due to surface damage of aircraft windows and antennas caused by atmospheric particle effects is currently a very serious problem. Impact testing is currently underway in ground test cells such as the wind tunnels and arc facilities located at Arnold Engineering Development Center (AEDC). For these tests, instrumentation that can determine the velocity vectors and size distribution for a wide range of particles, including irregular crystalline particles is needed. In this proposal, we describe a probe that features a combination of spatially resolved velocity vector measurement capability of an LDV with an imaging sizing method which is not restricted to spherical particles. The resulting single probe will allow simultaneous single-particle 2-dimensional velocity and irregular particle size characterization in a diameter range of 0.1 mm to 1.0 mm, with an expected accuracy of 10%, and a velocity accuracy of better than 1%. It will have an easily adjustable probe volume dimension in order to cope with the expected different number densities and will be easily moved between facilities. In addition, the probe will feature a high spatial resolution in order to assess the spatial distribution of the particle accurately.

AEROMETRICS, INC.
550 DEL REY AVENUE
SUNNYVALE, CA 94086
Phone: (408) 738-6688
Topic#: 93-002 ID#: 93AED-025
Office: AEDC
Contract #: F40600-93-C-0003
PI: Dr. William D. Bachalo
Title: Instrumentation for Non-intrusive Water Droplet Size and Mass Flux Measurements Utilizing the Phase Doppler Method
Abstract: There is a need for non-intrusive instrumentation to characterize the drop size distribution and volume flux in support of on-line engine/inlet icing tests. The ducts may vary from three to twelve feet in diameter with flow field speeds from Mach

0.2 to 0.5. The Phase Doppler technique offers the best potential for making these measurements non-intrusively and with sufficient accuracy to meet the size distribution and volume flux accuracy requirement. Large optical systems that utilize Cassegrain mirrors will be considered. These systems have the aperture size that will ensure accurate size measurements and acceptable SNR. To process the signals reliably and at a very high data rate, the further development of the advanced Real-Time Signal Analyzer (RSA) using Fourier analysis will be part of the program. This new method for signal processing will be fully automated to minimize the need for user intervention. It also has excellent accuracy even at low SNR so it will meet the present requirements of accuracy in large scale facility operations. Software will be developed to expedite the measurements. A prototype system will be used to evaluate the potential of using this method for routine testing.

AEROSOFT, INC.
P.O. BOX 11334
BLACKSBURG, VA 24062
Phone: (703) 951-8051
Topic#: 93-150 ID#: 93WL6-067
Office: WL6
Contract #: F33615-93-C-2314
PI: DAVID C. SLACK
Title: Incorporation of Arbitrary Grid Patching into Gasp Version 3.0
Abstract: The objective of this Phase I research is to implement a conservative method for transferring data across arbitrary non-overlapping zonal interfaces in the CFD code GASP version 3.0. Th s task will involve a linear interpolation of primitive variables in three dimensions with a gradient weighted flux correction method aimed at maintaining global flux conservation. For applications such as complex internal flows and hypersonic vehicles where engine/airframe integration analysis is crucial, sophisticated multi-block structured grid techniques are required. These techniques must not only be flexible and easy to use, but they must also be accurate. An arbitrary zonal interface interpolation scheme with global flux conservation will provide these characteristics. The Phase II portion of this research will build on the Phase I work by considering additional state variable interpolations, non-overlapping grid topologies, time accurate calculations with moving grids, and interpolation across zonal boundaries between a structured and unstructured mesh. At the conclusion of this work, we will deliver and demonstrate the code to the Air Force including installation, software listings, a new GASP manual, and a training class.

AEROSPACE RECOVERY SYSTEMS, INC.
1381 ROUNDS AVENUE
GRANTS PASS, OR 97527
Phone: (503) 479-5956
Topic#: 93-158 ID#: 93XRX-072
Office: XRX
Contract #: F33657-93-C-2323
PI: Robert T. Kendall, Jr.
Title: Inflatable Airborne Manned/Unmanned Payload Delivery/Recovery Systems
Abstract: Several objectives in this proposal include systematic study of innovative ways and means to improve survivability and safety of airborne platforms (C-130, C-17, Helicopter), flight crew, paratroops, cargo and equipment. High altitude deployment and glide operations, and airborne snatch and recovery of individuals or cargo from ground or water pick-up sites will also be studied. This proposal will determine feasibility of faster payload extraction from platforms at lower altitudes and greater speeds, and high altitude payload deployment of inflatable gliders for pinpoint landings. Innovative cone-shaped decelerator and impact shock attenuator and glider configurations will be studied, based on proven prototype test vehicles, to determine the best means for rapid extraction/deployment to reduce dispersion of landed payloads. Feasibility of self-contained, stand-alone personnel and cargo deployment/extraction hardware, and safe recovery of personnel/cargo payloads during airborne post-mission snatch/recovery of SOF missions will be defined and studied. Current airborne delivery systems/methods will be compared to proposed innovative inflatable delivery and recovery vehicles to verify proposed systems advantages based on flight tests of existing flight tested inflatable systems. Objective results, findings and conclusions will be presented on completion of the feasibility study.

AES CORP.
285 NEWBURY ST.
PEABODY, MA 01960
Phone: (508) 535-7310
Topic#: 93-037 ID#: 93ES2-054
Office: ES2
Contract #: F19628-93-C-0225
PI: Michael J. Sherman
Title: Adaptive Communications Links for Physical Security Systems
Abstract: Compromise of security networks is easiest through the communication links. Wired links between sensors and their controls require skilled preplanning and installation. They are expensive to maintain, especially in the connections to central

security monitors and command centers. We propose to use a radio based communication system to replace the hardwire/fiberoptic links. This system is packet radio based and uses an adaptive method of network and communication optimization. The key feature is that each reporting node in the system is a transceiver that acts as independent data transfer switch. Each transceiver will automatically adapt to network fault problems, data errors, and change data routing patterns without human intervention. Radio packet transmissions will permit encryption and the use of anti-jamming techniques. AES will develop the software protocols and hardware needed to build a demonstration system which will automatically reconfigure and optimize the security network to pass data between each node and a central control. AES has extensive overseas and domestic experience in designing and installing radio based security systems. The military and commercial viability of this concept are manifest in ease of deployment, simplified skill level required for installation, multiple anti-jamming techniques, and elimination of repeaters.

AIREX CORP.
ROUTE 108
DOVER, NH 03820
Phone: (603) 742-3703

Topic#: 93-104
Office: PL6
Contract #: F04704-93-C-0006
PI: Jim Sedgewick

ID#: 93PL6-031

Title: Manufacture of Stator and Rotor Laminations/Cores for Missile SFIR Assembly

Abstract: Cost effective technologies do not exist to produce precision laminations for high efficiency magnetic components in critical applications. This solicitation presents an opportunity to replace diminishing manufacturing sources with emerging, environmentally compatible technologies. This proposal introduces Abrasive Waterjet cutting to the manufacture of laminations with high performance, magnetic materials to close tolerances. The resulting technology will provide cost effective, state of the art components for new products and existing designs. This Phase II proposal will: 1. Develop low cost, high resolution robotic control for Abrasive Waterjet systems with further application in factory automation systems and OEM equipment. 2. Provide automated in-process inspection techniques for magnetic evaluation of high accuracy components as required by ISO 9000, Military and NASA Quality Standards. 3. Introduce an innovative stack cutting process promoting cost savings and better performance in emerging industries such as electric cars, flat panel displays and magnetic bearings. 4. Advance commercial applications for Abrasive Waterjet cutting while providing new manufacturing methods for very small, mechanical components in critical applications.

AKM ASSOC., INC.
635 MARINER'S ISLAND BLVD #205
SAN MATEO, CA 94404
Phone: (415) 571-7910

Topic#: 93-117
Office: WL3
Contract #: F33615-93-C-1238
PI: Dr. William R. Bush

ID#: 93WL3-050

Title: Application Specific Electronic Design Synthesis

Abstract: The Air Force and other DoD organizations are continuously developing new electronic components for their weapons and other systems. In this effort they are in need of tools to aid in the automated design, or synthesis, of these components. One component of particular importance is the computer processor. It is of enough importance that the Air Force has established a standard for this device (MIL-STD-1750A). The research proposed here applies a new processor synthesis technique, based on the methods of RISC computer design, to the synthesis of the Air Force's 1750A processor. This technique will automatically generate, from a single instruction set architecture specification of the 1750A, different implementations optimized for different applications, with the different implementations based on the instruction frequencies of the applications. Phase I of the proposed research will involve proof-of-concept tests of the synthesis technique and the development of a plan for constructing a robust tool implementing the technique. During Phase II the tool will be constructed, evaluated, and demonstrated. Furthermore, reference manuals and user guides will be developed and training provided to USAF personnel in its use.

ALPHATECH, INC.
EXECUTIVE PLACE III, 50 MALL RD.
BURLINGTON, MA 01803
Phone: (617) 273-3388

Topic#: 93-041
Office: ES2
Contract #: F19628-93-C-0147
PI: Jean MacMillan

ID#: 93ES2-117

Title: Applications of Neural Networks to Command Centers

Abstract: Continuing increases in computing capability present numerous opportunities to assist the staff of a command center

as they analyze enemy operations, construct and evaluate courses of action, and monitor the execution of the selected option. Nowhere are these opportunities more critical than in the areas of national and theater missile defense. ALPHATECH has developed the most advanced and mature fixed-algorithm decision aid for missile defense, the Look-Ahead Battle Planner, which evaluates the expected outcome of an engagement given certain data about threat and friendly forces. It is based on complex optimization algorithms which schedule interceptor missions against the expected target set. Recent advances in neural computing techniques offer the potential to augment this capability with faster, adaptive techniques which can be rapidly retrained as threat characteristics change. This proposal describes a program to implement and test a neural network which may provide order-of-magnitude increases in responsiveness. Our approach is to generate training and test data sets using the Look-Ahead Battle Planner, to develop and implement a neural network to assess potential battle outcomes given coarse information about threat and friendly forces, and to compare the performance and computational requirements of the neural approach with the existing aid.

AMERICAN COMPUTATIONAL TECH SVC, INC.
6921 CITRUS CIRCLE
HUBER HEIGHTS, OH 45424
Phone: (513) 667-8346
Topic#: 93-158 ID#: 93XRX-065
Office: XRX
Contract #: F33615-93-C-1300
PI: Michael J. Miedlar
Title: Automating the Creation of Technical Software
Abstract: Simulation provides a means of duplicating the operating environment of a topic of interest in a laboratory setting, but the environment itself is rarely the topic of interest. Providing the simulated environment requires access to personnel with expertise in the environment but without expertise in the topic actually to be studied, consuming resources but only providing the means to complete the project, not directly contributing to the project objectives. Other personnel are required to actually complete the project. This proposal describes the tools which allow someone not expert in a field to generate models in that field, or which allow someone with expertise but lacking programming experience to generate software.

AMERICAN ELECTRONICS, INC.
9332 ANNAPOLIS ROAD
LANHAM, MD 20706
Phone: (301) 459-4343
Topic#: 93-167 ID#: 93WL0-087
Office: WL0
Contract #: F08630-93-C-0034
PI: Patrick W. Johnson
Title: Two-Dimensional Electronically Steerable Mono-pulse Millimeter Wave Antenna
Abstract: An electronically scanned conformal array is proposed for a new generation of air-to-air missile seeker antenna. This new type of antenna array has the potential to impact the capabilities and performance of new missiles in multiple areas. 1. Cost Reduction. 2. The seeker antenna system proposed is predicted to be considerably simpler to manufacture thereby reducing the cost. 3. This conformal array approach removes the requirement for a costly radome assembly. This will reduce boresight errors and power loss resulting from the radome and makes the area at the nose of the missile available for other complementary sensors. 4. The antenna system and the proposed associated feeds and operating system will preclude the need for phase shifters and other expensive phased array technology. 5. Gimballed antennas are not required. 6. The proposed antenna system will have a higher reliability with fewer parts and no moving parts. 7. Because of the absence of the radome requirement, the system is compatible with all seeker frequencies through 94 GHZ. 8. No requirement for a rolling airframe to unmask mono-pulse blind areas. The array antenna achieves the electronic equivalent to a rolling mono-pulse by using banks of 8 elements, switched electronically, to achieve 2 sets of orthogonal views 45 degrees apart.

AMERICAN GNC CORP.
9131 MASON AVENUE
CHATSWORTH, CA 91311
Phone: (818) 407-0092
Topic#: 93-106 ID#: 93PL6-042
Office: PL6
Contract #: F04704-93-C-0017
PI: Drs Lin & Yang
Title: Autonomous Navigation with Passive Imaging Sensors
Abstract: American GNC (AGNC) Corporation proposes a new and innovative navigation processing and updating system for ICBM applications using imaging sensors. The approach is motivated by biological system excellence in navigation with visual cues only. Imaging sensor-based optical flow field provides complete and sufficient information, namely, the ship motion and environment information, to guide and control a vehicle. In the proposed system, a sequence of images supplied by the sensors

are processed to obtain optical flow measurements. Angular rates of roll, pitch, and yaw are then derived as well as the environmental information. Navigation solution is finally obtained as in a strap-down navigation system. The emphasis of the project will be placed on the development of high accuracy, robust, and computation efficient optical flow estimation and on the analysis of error sources to determine the navigation error budget and the magnitude of individual contributors. In Phase II, the algorithms will be fully developed and the performance will be demonstrated on typical scenarios with realistic data.

AMERICAN GNC CORP.
9131 MASON AVE.
CHATSWORTH, CA 91311
Phone: (818) 407-0092
Topic#: 93-114
Office: WL2
Contract #: F33615-93-C-1353
PI: Dr. C. Yang
ID#: 93WL2-009

Title: Integrated Fire Control/Weapon System Design and Evaluation for Internetted Applications

Abstract: The integrated fire control/weapon system design is an important part of the general effort in integrated avionics, flight control, fire control, and weapon systems design to improve weapon effectiveness and aircraft survivability. The delivery accuracy can be improved through reducing the effects of significant error sources in targeting, fire control, and weapon systems. The increase in survivability results from the covert action and earlier disengagement provided by internetted operations. In this project, a thorough investigation of internetted fire control and weapon delivery designs is proposed from the system integration point of view. In Phase I, a baseline fire control/weapon delivery system simulation tool will be developed. Major error sources and their contributions to the overall error budget will be identified. Algorithms designed to reduce these errors within internetted environment will be developed including multisensor integration, data association, IMU alignment, trajectory shaping guidance. Advantages associated with internetting operation such as passive, cooperative fire control and enhanced reliability and flexibility will also be investigated. In Phase II and Phase III, the resulting algorithm will be further refined and perfected to support operational capability.

AMERICAN GNC CORP.
9131 MASON AVENUE
CHATSWORTH, CA 91311
Phone: (818) 407-0092
Topic#: 93-164
Office: WL0
Contract #: F08630-93-C-0023
PI: Dr. C.F. Lin/Dr. J. Huang
ID#: 93WL0-055

Title: Robust Non-linear Autopilot Designs for HAVE DASH II Missiles

Abstract: The non-linearity and uncertainty inherent in the HAVE DASH II missile's dynamics have been a great challenge to the autopilot design that is required to have satisfactory performance for all flight conditions in probable engagements. Several advanced robust non-linear approaches, namely, inversion-based control laws, analytical gain scheduling, and non-linear servo-regulator are proposed to design a high performance autopilot. The unique features of these approaches include that (1) they incorporate the non-linear dynamics due to severe kinematic and inertial coupling as well as aerodynamics into the design process; (2) they furnish robust scheme to account for model uncertainties due to aerodynamics and bending motion, etc; and (3) they provide adaptive mechanism to handle parameter variations of the mass and inertia, etc. Each of these features works to enhance the performance of HAVE DASH II missiles. The deliverables include a comprehensive non-linear design/analysis tool together with detailed documentation, and training courses.

AMERICAN RESEARCH CORP. OF VIRGINIA
P.O. BOX 3406
RADFORD, VA 24143
Phone: (703) 731-0655
Topic#: 93-138
Office: WL5
Contract #: F33615-93-C-5366
PI: Dr Russell J Churchill
ID#: 93WL5-146

Title: Infrared Differential Reflectometer for Rapid Inspection of Aircraft Subsurface Corrosion

Abstract: Subsurface corrosion has been implicated in a number of incidents in which aircraft have demonstrated a loss of structural integrity leading to emergency procedures and in one case, the loss of human life. Although several techniques are available to evaluate subsurface corrosion, no method has shown the ability to scan rapidly a wide area of the aircraft to alert maintenance personnel to the need for intensive inspection procedures. To meet this need, this proposal suggests the development of an infrared differential spectral reflectometer for detection of corrosion products beneath coated aircraft surfaces. The proposal is innovative in combining differential reflectance spectroscopy for in situ electrochemical evaluation of materials with infrared image detection to provide a non-contact, electrochemical, nondestructive evaluation method for aircraft inspection.

The Phase I technical objectives include the development of an accelerated corrosion facility, acquisition of families of test data, application of signal processing procedures, and optimization of the Phase I instrument for development in Phase II of the program.

AMERICAN RESEARCH CORP. OF VIRGINIA
P.O. BOX 3406
RADFORD, VA 24143
Phone: (703) 731-0655
Topic#: 93-156 ID#: 93WL6-239
Office: WL6
Contract #: F33615-93-C-2375
PI: DR RUSSELL J. CHURCHILL
Title: Analysis and Control of Magnetic Bearings Using Neural Networks for Turbine Engine Applications
Abstract: The Air Force has identified a need for more advanced digital control methodologies to make feasible the appl of active magnetic bearings to turbine engines. Achieving the goals for enhanced turbine rotor performance nece improved bearing control with associated compact size/weight, fault tolerance, and minimum power consumption. Conver control methods are inadequate because of the wide and highly non-linear operating regimes which can occur due to unbalance or shaft critical speeds. To address this need, American Research Corporation of Virginia proposes the development and training of an innovative hardware based multiple layer, feed-forward neural network capable of addressing non-linear operational conditions. The program is innovative in combining neural networks and digital systems into a hybrid adaptive control package to provide robust control of magnetic bearings under non-linear conditions. Technical objectives include selection of neural network configurations, development of a training set, evaluation of hybrid controller response, and demonstration of the proof-of-concept system. The proposed effort will demonstrate the feasibility of a neural network-based controller to provide superior engine performance. Results anticipated include neural network definition, system implementation, stability margins, fault tolerance and compactness. The significance of the program is related to the improved control of advanced gas turbine and other rotating machinery systems made possible by neural network adaptive control.

AMERICAN SPUTTERING TECHNOLOGIES
3366 BERNARDO LANE
ESCONDIDO, CA 92029
Phone: (619) 432-6753
Topic#: 93-124 ID#: 93WL4-003
Office: WL4
Contract #: F33615-93-C-3204
PI: Dr Steven C. Yerkes
Title: Sputtering of Smart-skin Structures
Abstract: Smart-skin is an emerging technology which has tremendous potential for military aircraft applications. All military aircraft employ large numbers of antenna apertures for a wide variety of communication and radar functions. An ideal smart-skin would consist of a multi-function, multi-mode antenna integrated into the aircraft skin to provide a single, reconfigurable sensor suit capable of performing all of the required avionics functions for a given combat aircraft. American Sputtering Technologies has developed a unique sputtering process system that has the flexibility and capability to manufacture conductive smart-skin structures that incorporate embedded electronics for sensing applications. We propose to manufacture a new material that combines the best composite materials with our advanced metallization techniques. The proposed program will utilize close coordination with both Northrop Corporation and TRW MEAD, so that qualified test scenarios and viable aircraft structural composite systems are addressed. Several coupon samples will be metallized and subjected to stress/adhesion tests. The identification of successful metal/composite systems that are low cost and lightweight is the primary goal for Phase I. The Phase II effort will concentrate on increasing the physical size and production volume of these conductive smart-skin structures and the generation of a mechanical property data base.

AMHERST SYSTEMS, INC.
30 WILSON ROAD
BUFFALO, NY 14221
Phone: (716) 631-0610
Topic#: 93-111 ID#: 93WL2-055
Office: WL2
Contract #: F33615-93-C-1234
PI: David Hughes
Title: Reconfigurable, Real Time RWR (R3WR) Simulator
Abstract: This proposal describes a basic research effort to establish the feasibility of a cost-effective, modular, high-fidelity, reconfigurable, real time simulator of radar warning receivers. An open architecture, multiprocessor design for the simulator is proposed which will allow individual EW processing functions to be evaluated in the context of full EW system operations in dense, real time mission signal environments. The proposed study consists of a top-down requirements study, preliminary

design of the simulator, an RWR simulation example, and a real time demonstration of a baseline RWR simulator using an Amherst Systems' CEESIM to provide stimulus, and the USAF ARPS as the baseline simulator.

AMHERST SYSTEMS, INC.
30 WILSON ROAD
BUFFALO, NY 14221
Phone: (716) 631-0181
Topic#: 93-116 ID#: 93WL2-111
Office: WL2
Contract #: F33615-93-C-1244
PI: Robert Giza
Title: FLASER Simulation Environment Development
Abstract: The Flaser system engineering program scheduled for commencement in FY93, integrates a forward looking IR (FLIR) sensor and laser radar (ladar) for improved airborne targeting. The proposed effort supports the integration of passive IR and closed-loop active IR scene generation capabilities with the Khoros software environment. This marriage supports pending software development activities by providing extended data processing and visualization capabilities for multisensor concept development and evaluation.

AMITA
1444 CALLE GRANDE
FULLERTON, CA 92635
Phone: (714) 529-4065
Topic#: 93-068 ID#: 93PL1-050
Office: PL1
Contract #: F29601-93-C-0091
PI: DAVID G. PAQUETTE
Title: Carbon-carbon Joining Technology for Space Structures
Abstract: A plan is proposed to investigate high temperature brazing of carbon-carbon composites using polymer derived ceramic materials as a braze material. This Phase I program will demonstrate the viability of this approach. Experimental work will investigate the interlaminar properties of laminated carbon-carbon bond specimens. Experimental variables shall include types of polymers, fillers for the bonding material, and pressure during the bonding cycle. Mechanical testing will be used to compare process variables to each other and to unbonded carbon-carbon. Micro-analysis of process materials will document characteristics of the bond zone.

AMITA
1444 CALLE GRANDE
FULLERTON, CA 92635
Phone: (714) 529-4065
Topic#: 93-094 ID#: 93PL3-005
Office: PL3
Contract #: FO4611-93-C-0098
PI: David G. Paquette
Title: Advances in Electric Propulsion Insulators
Abstract: A plan is proposed to investigate several particulate reinforced ceramic composites that show promise of having good electrical insulation properties at temperatures approaching 3000 degrees Centigrade. In addition, good thermal shock resistance, machinability, and durability for continuous use at maximum temperature are required. Previous studies have shown that the micro-structure required for machinability and thermal shock resistance will consist of an insulation matrix surrounding disk shaped particles of a second phase. The second phase should have significantly different mechanical properties than the matrix in order to assure a high level of crack growth inhibition and crack branching. The text of the proposal provides specific recommendations of material selections that will be prepared. High temperature screening test shall be performed to assess the performance of the material specimens that are prepared. Tests shall include high temperature exposure evaluation, electrical conductivity measurements, and thermal conductivity measurements.

ANALYTICAL SERVICES & MATERIALS, INC.
107 RESEARCH DRIVE
HAMPTON, VA 23666
Phone: (804) 865-7093
Topic#: 93-184 ID#: 93WL9-044
Office: WL9
Contract #: F33657-93-C-2227
PI: H. Neal Kelly
Title: Refractory Composite Convection/Transpiration (CONTRAN) Cooling for NASP Engine Combustor
Abstract: An innovative actively cooled structure concept is proposed which integrates proven cooling techniques and state-of-the-art fabrication methods to extend the maximum combustor wall temperature, thereby reducing cooling requirements and aircraft weight while improving engine performance. Specifically, CONvective and TRANspiration cooling(CONTRAN)

are uniquely combined, relying on hydrogen coolant to permeate a carbon-carbon structure providing oxidation and thermal protection. State-of-the-art fabrication techniques will be used during Phase I to develop the desired carbon-carbon permeability specimen based on thermal and boundary layer analytical estimates and experimental testing refinements. Preliminary characteristics will be defined based on results from undensified and densified carbon-carbon permeability tests, thermal and structural analysis, and shock impingement and coolant compatibility reviews. In Phase II, final concept design verification models will be fabricated and tested in realistic flowing gas environment representative of the NASP engine combustor. Based on the concept verification tests, a prototype 20 by 20 inch test panel of a CONTRAN cooled NASP engine combustor wall will be designed and analyzed. Pending funding, Phase II could include the fabrication and testing of the 20 by 20 inch panel.

ANRO ENGINEERING, INC.
450 BEDFORD STREET
LEXINGTON, MA 02173
Phone: (813) 957-3080
Topic#: 93-164 ID#: 93WL0-011
Office: WL0
Contract #: F08630-93-C-0032
PI: Gerald F. Ross, Ph.D.
Title: Low Cost, General Purpose Ultra-wideband (UWB) Radar Fuze
Abstract: A low-cost radar fuze is proposed based on an innovative impulse-generated Ultra-Wideband (UWB) source developed by ANRO Engineering, Inc. (ANRO) under IR&D Funds. The new source offers simplicity of design and implementation, and inherent jam resistance and low probability of intercept properties. UWB waveforms provide superior range accuracy and resolution, which permits precise timing control for the detonation of warheads. ANRO has recently been allowed a patent for a very low-cost (less than $100), solid state, 1 kilowatt UWB transmitter source with a 1 nanosecond pulse duration and up to 35 KHz pulse repetition rate. Comparable breakthrough improvements in impulse receiver technology by ANRO provide the basis for the development of a highly effective fuze for advanced smart munitions. This Phase I effort will accomplish exploratory development of an innovative highly accurate, robust radar fuze that is unconstrained by weather and jamming. The development of the sensor will be based upon previous successful efforts exploiting UWB technology by ANRO. A brassboard transmitter/receiver using a modified antenna array will be designed, built and tested to form the basis of the sensor. Field tests are also proposed as an option under Phase I with AF personnel .

APA OPTICS, INC.
2950 NE 84TH LANE
BLAINE, MN 55449
Phone: (612) 784-4995
Topic#: 93-018 ID#: 93AFO-016
Office: AFOSR
Contract #: FQ8671-9301316
PI: Dr M. Asif Khan
Title: A Phototransistor Based on GaN-A1xGa1-xN Heterostructure
Abstract: We propose to demonstrate the feasibility of fabricating a phototransistor using the A1xGa1-xN material system. The proposed phototransistor is based on a GaN-A1xGa1-xN heterojunction which exhibits a 2-D electron gas conduction when a bias is applied on the source-drain terminals. The device is maintained in a nominally OFF state by applying a reverse bias voltage on the gate terminal. With optical radiation (ultraviolet) incident on the device from the transparent (sapphire) substrate side, electron hole pairs are generated and the device is switched to the ON state due to the reduction in the reverse bias depletion voltage. High electron currents are expected due to the 2-D electron gas conduction implying a large current transfer ratio for the device. Because of the large bandgap of the A1xGa1-xN material system such a phototransistor in principle should be usable in high temperature applications. In Phase I we will prove the feasibility of our technical approach by fabricating large area devices. In Phase II the devices will be optimized to obtain high speeds and performance levels.

APA OPTICS, INC.
2950 NE 84TH LANE
BLAINE, MN 55449
Phone: (612) 784-4995
Topic#: 93-121 ID#: 93WL3-008
Office: WL3
Contract #: F33615-93-C-1260
PI: Dr. M. Asif Khan
Title: Optoelectronic Integrated Circuits Based on Single Crystal GaN Waveguides
Abstract: We propose the exploration of single crystal GaN waveguides for the fabrication of optoelectronic integrated circuits. The feasibility of using GaN for short wavelength (up to 365 nm) OEIC's will be established in Phase I via the demonstration of a channel waveguide based phase shifter. The Al(sub x)GA(sub 1-x)N material system with its transparency from 365 nm to 12 microns, tunable refractive index (with alloy composition) and a high electro-optic coefficient is an excellent choice for

fabricating short wavelength waveguide devices. It also has been deposited in excellent single crystal form over substrates such as sapphire, GaAs and silicon which makes possible integration of control and driver electronics along with the guided wave components. With our demonstration of GaN planar waveguides and measurement of the material electro-optic coefficient we are in a good position to demonstrate a channel waveguide based phase shifter in Phase I. This will be followed by the fabrication of an active OEIC component such as a modulator in the Phase II effort.

APD CRYOGENICS, INC.
1833 VULTEE STREET
ALLENTOWN, PA 18103
Phone: (215) 791-6700
Topic#: 93-092
Office: PL3
Contract #: FO4611-93-C-0080
PI: Joseph Pfahler, PhD
ID#: 93PL3-064
Title: Prototype Storage and Delivery Device for Cryogenic Solid Hydrogen Propellant
Abstract: The use of cryogenic solid hydrogen as a rocket propellant may lead to major advances in rocket propulsion. To use solid hydrogen as a propellant requires a system designed to solidify, store, and transport hydrogen. We propose to study different methods for creating H2 for more than one hour at temperature less than 10 K. Alternative methods of delivering the solid hydrogen to the combustion chamber will be investigated. The solid hydrogen must be surrounded with low pressure H2 gas or cold He gas to prevent it from melting. A possible delivery system could use a pneumatically driven piston to force the H2 into the chamber.

APPLIED ENGINEERING TECHNOLOGIES, LTD.
155-B NEW BOSTON STREET
WOBURN, MA 01801
Phone: (617) 932-3221
Topic#: 93-012
Office: AFCESA
Contract #: FO8635-93-C-0116
PI: JAMES F. MAGUIRE, JR.
ID#: 93AFC-183
Title: Proposal for the Development of a CFC Cleanup System
Abstract: This project will investigate the feasibility of a portable, lightweight, CFC recovery unit which has no mechanical components exposed to the CFC. This type of system would be useful in the removal, storage, and disposal of CFC systems in the field. The advantage to this system is that it has no mechanical parts exposed to the CFC source, because worn or broken parts can damage a mechanical system; this unit should be far more reliable.

APPLIED MATERIAL TECHNOLOGIES, INC.
3611 SOUTH HARBOR BLVD, STE 225
SANTA ANA, CA 92704
Phone: (714) 545-8825
Topic#: 93-132
Office: WL5
Contract #: F33615-93-C-5348
PI: William E Davis
ID#: 93WL5-005
Title: Carbon-carbon Heat Sink Components for High Density Electronics Packaging
Abstract: Carbon-carbon is a unique composite material that achieves the highest in-plane thermal conductivity and also achieves very high Young's modulus (40-50 MSI). This research project will demonstrate the feasibility of C-C as an effective heat sink material for electronic packaging. Three to five carbon-carbon materials will be designed and analyzed in the required packaging configuration with appropriate mechanical and thermal loads applied. Based on the analysis results, one to three of the material designs will be selected and coupon test samples will be fabricated. Mechanical, thermal and physical property measurements will be made. Based on the analysis and test results one or more of these material designs will be selected for phase II development. An agreement has been made with Honeywell Space Systems Operation (Phoenix, AZ) to work with AMT to develop a product that will use C-C material for their spacecraft applications. BF Goodrich, a fabricator of high thermal conductivity C-C material, will be the material supplier for the phase I effort.

APPLIED OPTRONICS CORP.
111 CORPORATE BLVD., BUILDING J
SOUTH PLAINFIELD, NJ 07080
Phone: (908) 753-6300
Topic#: 93-079
Office: PL1
Contract #: F29601-93-C-0056
PI: DR. KEVIN MA
ID#: 93PL1-078
Title: MOCVD Growth and Fabrication of High Power Mid-infrared GaInAsSb/GaAs Diode Lasers for Operation at 2 - 5 Microns

Abstract: It is the goal of Applied Optronics to develop, fabricate and package antimony alloy diode lasers capable of high power operation at wavelengths between 2 and 5 microns, and to design a practical, high performance master oscillator power amplifier (MOPA) device based on antimony alloy diode lasers. In the proposed effort, Applied Optronics will use newly developed aluminum, gallium, and antimony metal organic sources to grow high purity, narrow bandgap III-V materials by the MOCVD technique. These new sources have been demonstrated to reduce carbon contamination in MOCVD grown materials, and will allow Applied Optronics to grow antimony alloy, high power laser structures with improved performance in the 2 to 5 micron band compared to existing semi-conductor lasers. Applied Optronics will design these devices for later integration into a MOPA device. Objectives include design of a high power GaInAsSb/AlGaAsSb laser structure, growth by MOCVD using trimethylamine alane (TiPSb), development of a suitable device fabrication process including etching, coating and metallization for GaInAsSb/AlGaAsSb laser and MOPA structures, and design of a MOPA device in the antimony alloy material system.

APPLIED OPTRONICS CORP.
111 CORPORATE BLVD., BUILDING J
SOUTH PLAINFIELD, NJ 07080
Phone: (908) 753-6300
Topic#: 93-088 ID#: 93PL1-026
Office: PL1
Contract #: F29601-93-C-0078
PI: DR. C. J. HWANG
Title: Advanced Fiber Coupled Semi-conductor Lasers: A Compact 10 Watt Demonstrator
Abstract: Because of the extreme compactness, very good portability, reliability, and ease-of-use of the diode lasers, high power systems that combine the light from several diode lasers offer significant ergonomic and economic advantages over solid state lasers in many applications. Applied Optronics Corp proposes to develop and demonstrate a compact, reliable, diode laser device that will produce 10 watts (CW) from a fiber, for use in self-contained, portable systems. As opposed to the established approach of coupling a linear array of emitting elements into a single fiber, our novel approach relies on multiple, individual lasers, each coupled to its own fiber. The individual fibers are then combined into a compact bundle with the smallest possible diameter. This approach offers the advantages of individually replaceable lasers, the use of standard fibers and packaging that simplifies heat management.

APPLIED PHYSICS TECHNOLOGIES CORP.
LONG ISLAND HI TECH INCUBATOR, 25 EAST LOOP ROAD S
STONY BROOK, NY 11790
Phone: (516) 444-8802
Topic#: 93-034 ID#: 93AL -073
Office: AL
Contract #: F41624-93-C-9010
PI: Dr. Argyrios Doumas
Title: Development of a low Energy X-ray Detector to Replace Bag-X
Abstract: The USAF Armstrong Laboratory is interested in improving the detection sensitivity of a CaF2 (EU) based detector system (BAG-X) for performing field measurements of low energy (17 keV and 60 keV) x-rays. The detection sensitivity of a system can be enhanced by improving its energy resolution, increasing its area efficiency and/or improving the signal processing electronics. Since the late 1970's, advances have been made in each of these areas so that a new design approach for BAG-X could result in a significant improvement to its detection sensitivity. New packaging approaches for hygroscopic scintillators, which typically offer better energy resolution and area efficiencies to CaF2(Eu), could result in their use in harsh environments which necessitate rugged systems. The ability to build compact, light-weight and powerful electronics for signal processing, on-the-fly background subtraction, etc. offers improvements to both the detection sensitivity and the confidence level that a source is present. In addition, electronics advances have made portable systems easier to use and more intelligent compared to rate meters used 15 years ago. We propose to investigate which of these enhancements can be incorporated into BAG-X and to define a design approach for a new system.

APPLIED SCIENCE & TECHNOLOGY, INC.
35 CABOT ROAD
WOBURN, MA 01801
Phone: (617) 933-5560
Topic#: 93-149 ID#: 93WL6-204
Office: WL6
Contract #: F33615-93-C-2344
PI: EVELIO SEVILLANO
Title: Diamond Deposition on Non-planar Substrates
Abstract: The deposition of a thermally conductive, insulating film of diamond onto high power electronic devices is important for packaging applications for corrosive environments, or high power applications where coolants are used for thermal management. Deposition of diamond will require a basic understanding of plasma physics fundamentals governing interfaces

(24)

between plasma and substrates, and intelligent application of low and high pressure plasma processes. The proposed work will be focused on diamond deposition on nonplanar surfaces using a novel plasma process consisting of low and high pressure steps, respectively, for diamond nucleation and growth. The effect of substrate topography on film uniformity and growth rate will be investigated. A low temperature, low pressure nucleation process will be combined with an existing low temperature growth process to identify physical mechanisms and limitations for diamond nucleation and growth on nonplanar substrates.

APPLIED SCIENCE LABORATORIES
335 BEAR HILL ROAD
WALTHAM, MA 02154
Phone: (617) 890-5100
Topic#: 93-023 ID#: 93AL -121
Office: AL
Contract #: F41624-93-C-6006
PI: Joshua Borah
Title: Fighter Cockpit Precision Cursor Control
Abstract: We propose to demonstrate that eye slaved cursor control, using an eye tracker device, is a viable and potentially more valuable man-machine interface than current manual cursor control techniques. This control technique can provide potentially higher bandwidth cursor control, while minimizing pilot attention when compared to manual control techniques. We will demonstrate concept feasibility with a demonstration in a laboratory situation which incorporates the ergonomic and operationally relevant components of the fighter cockpit application. These components include display visual angles, information density, information type, type of cursor control task, and pilot feedback. After demonstrating feasibility, we will address all technology issues pertaining to the militarization of the concept, and prepare a program plan for prototyping a flyable, eye tracker based, cursor controller.

APPLIED SCIENCES LABORATORY, INC.
POST OFFICE BOX 21158
ALBUQUERQUE, NM 87109
Phone: (505) 828-1848
Topic#: 93-073 ID#: 93PL1-224
Office: PL1
Contract #: F29601-93-C-0041
PI: DR. PETER SOLIZ
Title: Model-based Object Identification & Multisensor Fusion of Images of Satellites
Abstract: An approach is presented to solve both the data fusion problem, and the space object model building requirement for the Air Force Phillips Laboratory. Artificial neural network (ANN) technology provides a number of tools that form the basis of this proposal and the foundation for the solution to the real-time data fusion problem. ANNs are a proven technology that offer a powerful, naturally parallel computational technique for highly distributed processing. The need is for procedures that can readily adapt to additional target classes, new sensors and widely variable viewing environments. Finally, effective target identification and characterization is greatly enhanced if a priori knowledge about the target is integrated into the data processing. A model-based process is presented to update and enhance the spectral properties, thermal condition, orientation, and the spacecraft's geometric configuration. A model-based fusion process based on feature extraction using a neocognitron neural network will be developed to integrate spatial and spectral data and create or update a three-dimensional satellite model. The fusion process will specifically accommodate wide band radar (Inverse Synthetic Aperture Radar-ISAR), visible, and infrared wavelength imagery and signature information of low Earth orbiting satellites. The final high fidelity satellite model will be portable through the International Graphics Exchange Standard (IGES).

APPLIED TECHNOLOGY ASSOC., INC.
1900 RANDOLPH RD., SE
ALBUQUERQUE, NM 87106
Phone: (505) 247-8371
Topic#: 93-083 ID#: 93PL1-209
Office: PL1
Contract #: F29601-93-C-0068
PI: HENRY R. SEBESTA
Title: Adaptive Optics Control Systems Analyzer (AOCSA)
Abstract: This project addresses the development of software technologies to collect, analyze, and display test data from adaptive optics control systems. Innovative technologies are devised which allow efficient processing of data from multiple-input/multiple-output (MIMO) systems involving deformable mirrors, electronic signal processing, wavefront sensors, actuator arrays, and other physical elements which comprise the adaptive optics control systems. The project develops tools for acquisition, processing, analysis, display, and management of data associated with MIMO systems. The available features allow users to evaluate stability and stability robustness, temporal and spatial response, frequency domain characterizations, inter-channel coupling, noise and uncertainty measures, test excitations, modulation transfer function, Strehl ratios, and other

25

functions useful in testing of adaptive optics control systems. The proposed Adaptive Optics Control System Analyzer (AOCSA) meets the requirements by exploiting and integrating technologies from three areas. First, common algorithms from the signal and image processing theory (Fourier transforms) and their advanced off-shoots, such as coherence functions, are used to ensure quality measurements and correct interpretation of results. Second, the theories and algorithms applicable to adaptive control system performance and stability measures are framed into user interfaces and displays which support the treatment and interpretation of experimental data. Last, the technologies of processors, data acquisition support electronics, commercial executive software environments, and special "toolbox" packages are used as the basis for implementing a user-friendly AOCSA.

ARROW TECH ASSOC., INC.
1233 SHELBURNE ROAD; D-8
SOUTH BURLINGTON, VT 05403
Phone: (802) 865-3460
Topic#: 93-006 ID#: 93AED-060
Office: AEDC
Contract #: F40600-93-C-0011
PI: John R. Burnett
Title: Hypervelocity Projectile Balloting Model
Abstract: Existing balloting codes do not consider all of the forces and interactions that contribute to balloting of hypervelocity projectiles. This effort will result in the definition of a complete mathematical model and the design of an appropriate, user friendly, computational model to predict hypervelocity projectile balloting. Arrow Tech, whose engineers are well known for the development and applications of state-of-the-art analysis techniques (including balloting codes), will subcontract with Dr. Courter of Louisiana State University (LSU), who is a recognized expert in hypervelocity ranges and gas dynamics, to develop the required models. This proposal will describe the background and expertise Arrow Tech / Dr. Courter will apply towards combining current balloting and gun dynamic analysis techniques with hypervelocity gun gas dynamic and projectile wear analysis methods into a comprehensive, practical, cost effective engineering tool for hypervelocity range facilities.

ASPEN SYSTEMS, INC.
184 CEDAR HILL STREET
MARLBOROUGH, MA 01752
Phone: (508) 481-5058
Topic#: 93-010 ID#: 93AFC-041
Office: AFCESA
Contract #: FO8635-93-C-0099
PI: JOSEPH PICHE
Title: Novel Deicing/Anti-icing Materials with Enhanced Environmental Acceptability
Abstract: Aspen Systems, Inc. proposes the program "Novel De-icing/Anti-icing Materials with Enhanced Environmental Acceptability." We will evaluate novel deicing and anti-icing materials that perform equal to or better than current materials, including the naturally occurring Anti-Freeze proteins, alanine-rich polypeptides, CaMg Acetate, and other materials as environmentally compatible deicing agents. We will test and rank these for overall deicing and anti-icing effectiveness by measuring mp depression and ice growth inhibition. This will create an evaluation matrix, including environmental compatibility (e.g., BOD), deicing effectiveness, and cost projections. Results on biodegradability and aquatic toxicity will provide a comprehensive understanding of their environmental fate relative to ethylene glycol and urea. We will emphasize the AF proteins including their analysis by computational modeling, to design a low-cost synthetic analog. Dr Welsh, University of Missouri, will contribute $50,000 in hardware and software for their evaluation. We will provide proof-of-concept for selected deicers, and validate their ability to meet Air Force regulation 91-15, and obtain approval from the Air Force Materials Laboratory. In Phase II, we will concentrate on a reduced set of deicing and anti-icing materials, obtain or produce quantities sufficient for large-scale field testing in conjunction with the Institute of Snow Research, KRC, Michigan Technological University.

ASPEN SYSTEMS, INC.
184 CEDAR HILL STREET
MARLBOROUGH, MA 01752
Phone: (084) 815-0582
Topic#: 93-179 ID#: 93WL0-216
Office: WL0
Contract #: F08630-93-C-0047
PI: Jae Ryu, Ph.D.
Title: A Novel Explosive Initiator Material Utilizing Fullerenes
Abstract: Novel explosive initiator materials are proposed based on fullerenes containing energetic molecules. The proposed innovative multi-layer structure safely stores highly reactive fuel utilizing fullerene chemistry, isolated by a novel metal layer from an oxidant containing fullerene. The final structure will be a unique fullerene-fuel-oxidant composite that can initiate a rapid chemical reaction (detonation) by removal of the separating layer via an electrical discharge. In Phase I, we will identify

various energetic elements that can be safely incorporated into fullerenes. Furthermore, we will fabricate a multi-layer structure, which will consist of an oxidant/thin metal isolation layer/fuel/thick film packaging layer. We will initiate the fuel/oxidant reaction via rupturing thin metal isolation layer by applying voltage across the isolation layer. We will determine the transient time of detonation and the peak stress generated using a high speed photographic technique and x-cut quartz crystals, respectively. In Phase II, we will optimize the configuration of the multi-layer structure for the effective detonation of insensitive high explosives. Parameters to be optimized will be thickness, width and resistivity of the separation layer, and choice of reaction coupling and amount of the reactants to ensure safe and effective detonation of insensitive high explosives.

ASTROX CORP.
15825 SHADY GROVE ROAD
ROCKVILLE, MD 20850
Phone: (301) 935-5311

Topic#: 93-184
Office: WL9
Contract #: F33657-93-C-2229
PI: Thomas A. McLaughlin

ID#: 93WL9-027

Title: Analysis of Off-design Considerations for Innovative Single-stage-to-orbit Configurations

Abstract: An existing hypersonic vehicle design code predicts EISP performance increases of 200-400 seconds over traditional single-stage-to-orbit configurations. If realized, such increase may have profound effects on the vehicle weight and maximum airbreathing Mach number. To date, these improved results have only been obtained for vehicles at a specified design point, and no off-design analysis has been performed. The work suggested in this proposal takes the first steps toward assessing the feasibility of creating an off-design performance tool that is appropriate for conceptual design applications. As such, this tool should be capable of producing reasonable accuracy at a relatively high rate of computational speed. In addition, the suggested work also examines the feasibility of implementing the required variable geometry into the types of vehicle configurations that are created by the existing design code. Ideals and concepts for handling variable geometry considerations of a wide range of configurations will be proposed.

ATLANTIC AEROSPACE ELECTRONICS CORP.
470 TOTTEN POND RD.
WALTHAM, MA 02154
Phone: (617) 890-4200

Topic#: 93-035
Office: ES2
Contract #: F19628-93-C-0210
PI: Tamar Peli

ID#: 93ES2-005

Title: Morphology/Fractal-based Techniques for Automatic Target Discrimination

Abstract: This proposal describes an innovative approach to the detection and discrimination of targets in multi-sensor airborne platforms. The major advantages of our process are: 1) substantial performance gains; 2) the use of a common architecture for multi-sensor platforms; and 3) the need for less hardware for real-time implementation than current state-of-the-art techniques. Our proposed target detection and discrimination process combines two key technologies - morphological signal processing and fractal analysis. We will use geometric constraints (shape) as a first order filter for discriminating man-made objects from the natural cluttered background. This will be followed by a second step of processing (false alarm reduction and detection prioritization) which will exploit the difference in the fractal behavior of natural clutter vs. man-made objects. Both stages of the algorithm will be implemented using non-linear morphological filters, which require much fewer numerical operations than conventional signal processing algorithms. As a result we will achieve high computational efficiency and increased processing speed. For Phase I demonstration we will focus on one aspect of the Theater Missile Defense scenario. This approach offers a fast, low-cost, low-power common hardware implementation for the detection and discrimination of targets in multi-sensor data.

ATMOS & ENVIRONMENTAL RESEARCH, INC.
840 MEMORIAL DRIVE
CAMBRIDGE, MA 02139
Phone: (617) 547-6207

Topic#: 93-097
Office: PL4
Contract #: F19628-93-C-0062
PI: Ronald G. Isaacs

ID#: 93PL4-003

Title: Development of a Multispectral Infrared All Sky Imager for Cloud Property Retrieval

Abstract: This study proposes the development of an infrared all sky imager to provide accurate cloud property information with high spatial and temporal resolution. Infrared detection provides both day and night capabilities. An innovative aspect of the concept is exploitation of the information content of multispectral channels to facilitate the determination of microphysical and optical properties. The Phase I effort employs: (a) radiative transfer based simulation modeling to support optimal channel

selection and bandpass determination, (b) multispectral cloud property retrieval algorithms to assess the accuracy of inferred cloud parameters, and (c) a detailed sensor feasibility and tradeoff study based on the results of (a) and (b) to determine design parameters. The results from the sensor feasibility study will include: (a) recommendations for the scanning, detector, cooling, and filter technology to employ, (b) a discussion on the computer processing and storage requirements to provide an autonomous near real-time processing capability, and estimates of the cost to design and build the prototype system.

AUTOMATED INSTRUMENTS
POST OFFICE 596
WHITE PLAINS, MD 20695
Phone: (301) 934-1859
Topic#: 93-034 ID#: 93AL -041
Office: AL
Contract #: F41624-93-C-9009
PI: Daniel M Smolenski
Title: Technology Assessment for an Electromagnetic Radiation Dosimetry Temperature Probe Interface
Abstract: Measuring temperature in specimens being heated by electromagnetic energy requires the use of special probes. The temperature probes must be specially designed to minimize electromagnetic field perturbations. The probes in widespread usage in research institutes are thermistor sensors with very high resistance leads. They are very similar to those described by R.R. Bowman (IEEE Trans. Microwave Theory Tech MTT 24:43-45, 1976). Although the probes are commercially available, an interface is required for standard laboratory computers. This study determines the feasibility and assesses the current technology for developing an interface between the non-perturbing temperature probes and a IBM PC compatible computer using commercially available components. At the completion of this study at least one preliminary design will be presented for development.

AVCON-ADVANCED CONTROLS TECH, INC.
19151 PARTHENIA STREET, UNIT G
NORTHRIDGE, CA 91324
Phone: (818) 886-0250
Topic#: 93-156 ID#: 93WL6-224
Office: WL6
Contract #: F33615-93-C-2329
PI: CRAWFORD R. MEEKS
Title: Advanced Digital Control Methodologies for Turbine Engine Magnetic Bearings
Abstract: Previous R&D at AVCON has developed miniaturized, power efficient, modular, scalable active magnetic bearings and control electronics for applications ranging from precision gimbals for sensors, to radial and thrust bearings for IHPTET type turbine engines, to radial and thrust bearings for SSME type rocket engine turbo-pumps. The current SBIR Project addresses a complementary digital electronics controller of small size, low weight, low power consumption and, at the same time, improved dynamic performance and robustness, by virtue of its being based on advanced control methodologies. The design approach concentrates on LQR, LQG, and H control methodologies because they provide performance improvement without incurring excess hardware and software complexity. Fault tolerance is obtained by the system architecture and reconfigurability, consistent with modern, integrated modular avionics, system concepts. The output of Phase I is the selection of a control methodology, design of the corresponding algorithm and the preliminary design of a controller, including top level circuit design. The selected design will be experimentally evaluated using a turbine engine magnetic bearing testbed being developed by AVCON (Contract F33615-91-C-2114). Digital servo electronics controller already developed by AVCON and Pratt & Whitney will be modified at no cost to the program.

BARRETT AEROSPACE TECHNOLOGIES
1500 WEST 9TH STREET, SUITE 3
LAWRENCE, KS 66044
Phone: (913) 841-1293
Topic#: 93-170 ID#: 93WL0-138
Office: WL0
Contract #: F08630-93-C-0039
PI: Ron Barrett
Title: Advanced Low Cost Smart Missile Fin Technology Evaluation
Abstract: Three areas of research on low cost, reliable, folding aero surfaces will be conducted. First, different types of fin deployment and flight control actuators will be examined. These include conventional fin actuators, shape-memory-alloy, piezoelectric, magnetostrictive, and electrostrictive actuators. Second, different fin designs will be examined. These candidate designs are capable of flight control and conformal folding around the fuselage. They include conventional fins, active aerodynamic plates, twist active, active camber, active servoflap and active aeroservoelastic fins. The third section of research will be composed of trade studies on the various fin designs, including: material costs, manufacturing costs, reliability, manufacturing feasibility, radar cross section, deployment time, occupation of fuselage volume, structural strength,

27

stiffness, weight, drag and power consumption. The three sections of research will lead to the selection of four preferred missile fin designs that are simple, low cost, reliable and capable of flight control without occupation of fuselage volume. There will be two preferred supersonic and two preferred subsonic designs chosen. A pair of these will be for stabilization and the other's will be used for flight control. This investigation will use smart structures to greatly simplify folding missile fin design which in turn will reduce costs, enhance reliability and improve overall performance.

BARRON ASSOC., INC.
RT 1, BOX 159
STANDARDSVILLE, VA 22973
Phone: (804) 985-4400
Topic#: 93-017
Office: AFOSR
Contract #: FQ8671-9301376
PI: Roger L. Barron
ID#: 93AFO-091
Title: Self Designing Flight Control System
Abstract: Technical advances made in related topics now point the way for optimum continuous, on-line, real-time, self designing flight control systems. These advances include (1) algorithms using neural networks to enhance on-line parameter estimation and continuous control reconfiguration, (2) analytically derived optimum control for the coupled non-linear inner loop and outer loop dynamics of high-performance flight vehicles, (3) synthesis of neural networks that initialize two-point boundary-value control solutions, (4) powerful airborne computing capabilities, and (5) new sensing techniques and adaptive materials. This proposal presents a unifying conceptual design framework for integration of these capabilities into self designing flight control systems to eliminate gain switching, accommodate failures and damage, maximize maneuverability and the flight envelope, and increase the probability of successful mission completion. In Phase I Barron Associates will refine this concept, assess its feasibility, practicality, and current technology limitations, develop critical analytical and computational tools, and perform preliminary simulations. In Phase II Barron Associates will implement the self designing controller and interface it with the simulation of a representative aircraft to demonstrate its operation in realistic scenarios.

BARRON ASSOC., INC.
RTE 1 BOX 159
STANDARDSVILLE, VA 22973
Phone: (804) 985-4400
Topic#: 93-123
Office: WL4
Contract #: F33615-93-C-3604
PI: Roger L. Barron
ID#: 93WL4-108
Title: Unified Control Concept for Advanced Flight Systems
Abstract: The position control of aircraft is inherently a two-point boundary-value problem, and aircraft rate and attitude control are desirably treated as such. The aircraft maneuvers from an initial state vector at a given initial time to a final state vector at a given or optimized final time. The final state is achieved in a manner that minimizes cost functions such as the time integral of induced drag. This is a classical problem in variational calculus, but until recently there has been no practical means for initializing the co-state differential equations of the calculus. This proposal presents a new method for this initialization that uses artificial neural networks trained off-line on simulated optimum solutions. The method is realizable in airborne systems without large computational capabilities. Phase I work will remove the remaining technical obstacles and demonstrate the method via simulations of an advanced aircraft controlled in complex maneuvering. A control synthesis tool that can be used by the entire flight control community will be fully developed in Phase II. The proposed method is called a "unified control concept" because it provides solutions for non-linear and time varying flight conditions, employs neural network based adaptive control, and provides analytically derived designs for rate, attitude, and position control laws.

BELTRAN, INC.
1133 EAST 35TH STREET
BROOKLYN, NY 11210
Phone: (718) 338-3311
Topic#: 93-011
Office: AFCESA
Contract #: FO8635-93-C-0098
PI: MICHAEL R. BELTRAN
ID#: 93AFC-054
Title: Non-equilibrium Plasma Chemical Process for Control of NOx, VOC's and Air Toxics
Abstract: Non-equilibrium plasma chemical processes (NEPCP) can be applied to the control of NOx, VOCs, and air toxics such as heavy metals, nitroaromatics, and other extraordinary active mutagens, from combustion and/or industrial sources, including vent and flue gases. The advantage of the non-equilibrium plasma chemical process for the control of NOx, VOCs, and air toxics is that it can operate at ambient temperatures, enabling its application after existing gas cleanup equipment such as electrostatic precipitators, scrubbers or bag houses or in processes where the VOCs or air toxics are from plant or building exhausts. Such

a process is also suitable for control of odors. It is felt that non-equilibrium plasma chemical processes are a new, innovative, and cost-effective approach to prevent and control NOx emissions from stationary and mobile sources. Due to the limited effort of the Phase I study and the many varied possibilities of the application of the non-equilibrium plasma chemical process to NOx, VOCs, and air toxics, the Phase I study will concentrate on (1) reduction of NO to nitrogen; (2) destruction of various industrial and commercial solvent vapors, such as styrene, naphtha, methyl ethyl ketone, toluene, benzene, perchloroethylene, trichloroethane and methanol; (3) destruction of nitroaromatic vapors, such as nitrobenzene and nitromethane; and (4) destruction of fuel vapors, such as gasoline and kerosene.

BERKELEY APPLIED SCIENCE & ENGINEER
5 THIRD STREET #530
SAN FRANCISCO, CA 94103
Phone: (415) 543-1600
Topic#: 93-015 ID#: 93AFO-082
Office: AFOSR
Contract #: FQ8671-9301351
PI: M Panahandeh, Ph.D, P.E.
Title: Structural Integrity of Intelligent Materials and Structures
Abstract: A full scale application of shape memory alloys in intelligent structures requires that the complex interaction between active elements (sensors, actuators, processors) and the host material be investigated. In the proposed research, i) constitutive equations to model the behavior of shape memory alloys under large deformations will be developed, ii) composite laminates will be modeled as a continuum with a micro-macro structure, iii) variational formulation of the governing field equations will be implementation in a finite element code and analysis of sensor/actuator interactions with composite laminates for different configurations or active elements.

BERKELEY MICROINSTRUMENTS
2375 CEDAR STREET
BERKELEY, CA 94708
Phone: (510) 849-9539
Topic#: 93-011 ID#: 93AFC-093
Office: AFCESA
Contract #: FO8635-93-C-0096
PI: STUART W. WENZEL
Title: Micromachined Sensor System for Selective Detection of VOC Pollutants
Abstract: We propose the first phase of a two-part research and development program aimed at realizing a practical silicon-based pollutant-monitoring technology. The microfabricated sensor chips that are the heart of the technology will respond to volatile organic compounds (VOCs). The chips employ ultrasonic measuring principles that have been shown in previous university research to result in extremely high sensitivity; in the work we propose, new techniques will be developed for achieving concomitant selectivity. The use of a silicon technology gives promise of a low-cost manufacture. The chips will be the basis of portable sensor systems that can be used for on-site VOC pollutant monitoring. The technology is generic in the sense that it can be applied later to the detection of other types of pollutants. In this phase we will design and build a chemical identification chip incorporating an ultrasonic flexural-plate-wave sensor and other micro-machined elements. We will design and test circuitry and algorithms to control the individual chip elements in order to make a chemical-measurement system. System performance will be measured upon exposure to two different volatile organic compounds in the presence of water vapor.

BIHRLE APPLIED RESEARCH, INC.
400 JERICHO TURNPIKE
JERICHO, NY 11753
Phone: (804) 864-1180
Topic#: 93-123 ID#: 93WLA-077
Office: WL4
Contract #: F33615-93-C-3601
PI: Edward G. Dickes
Title: Preliminary Design of a Test Rig for the Wright Laboratory's Vertical Wind Tunnel
Abstract: The Air Force currently lacks a facility to perform rapid turn-around parametric evaluation of low-speed, high angle-of-attack configuration development, modifications and flow field investigations. With the current trends in aircraft design and execution driving maneuvering requirements for military aircraft to progressively higher angles of attack the need for such a facility is becoming paramount. The availability of the existing research facility at Wright Laboratory's Vertical Wind Tunnel provides the opportunity to develop test apparatus to provide the necessary static and dynamic test information for the appropriate analysis and simulation of aircraft characteristics. As a result, a thorough evaluation of the Air Force facility in conjunction with future test requirements must be made to ensure that the new test apparatus will be capable of providing all required test data and will be of high quality.

BIO-IMAGING RESEARCH, INC.
425 BARCLAY BLVD
LINCOLNSHIRE, IL 60069
Phone: (708) 634-6425
Topic#: 93-138 ID#: 93WL5-151
Office: WL5
Contract #: F33615-93-C-5335
PI: Michael D Silver, PhD
Title: Reverse Geometry X-ray Source Volume CT
Abstract: X-ray computed tomography (CT) is widely used in defense, aerospace, and industrial applications. CT provides flaw detection, density measurement, accurate dimensions, morphology, assembly verification, material property analysis, and other valuable information. However, a major limitation of CT has been the inspection time required for 100% coverage of an object, since a single slice through the object usually requires several minutes. One promising technique to overcome this limitation is volume computed tomography (VCT). Instead of acquiring only a single slice from the object, VCT employs an area detector to collect hundreds of slices per exposure. VCT has been demonstrated in the laboratory as a promising NDE technique, but the limitations of area x-ray detectors and system costs above $1,000,000 have prevented any significant commercial applications. We propose to demonstrate the feasibility of a completely new concept of VCT, which overcomes the limitations of area detectors and conventional x-ray sources. This concept uses a raster scanned area x-ray source and a single, tightly collimated solid state detector. In addition to performing fast VCT, this approach will produce higher quality images than current VCT, since it eliminates the scattered x-ray signal at the detector.

BIODYNAMIC RESEARCH CORP.
9901 IH 10 WEST, SUITE 1000
SAN ANTONIO, TX 78130
Phone: (210) 691-0281
Topic#: 93-023 ID#: 93AL -090
Office: AL
Contract #: F41624-93-C-6011
PI: Dr. John B. Bomar
Title: Modeling Platform Dynamics and Physiologic Response to Short Arm Centrifugation
Abstract: An opportunity exists to develop a comprehensive model of the kinematics of a short-arm centrifuge, models of human physiologic response during centrifugation, and evaluation of techniques for balancing the torques created during operation of a short-arm centrifuge. The proposed Phase I program will include a detailed review of the literature, the synthesis and solution of a general mathematical model of short-arm centrifuge kinematics as well as physiologic models of the cardiovascular and vestibular system, and a design approach and research on a dynamic balancing concept for a short-arm centrifuge in space. The models will be partially validated against existing data to yield a Phase I model which could be employed as a tool for integrating existing physiologic knowledge and for guiding future research by explicitly identifying the new data required to more fully describe the physiologic consequences of short-arm centrifuge design and centrifugation protocols. A validated model of the cardiovascular and vestibular response to High Gradient Acceleration (HGA) is vital to development of centrifugation protocols and the interpretation of the experimental data in the context of the space-based scenario. The methods and approaches for balancing the torques created by centrifugation must be addressed to avoid destabilization of orbiting platforms equipped with a short-arm centrifuge.

BIODYNAMIC RESEARCH CORP.
9901 IH 10 WEST, SUITE 1000
SAN ANTONIO, TX 78230
Phone: (210) 691-0281
Topic#: 93-024 ID#: 93AL -020
Office: AL
Contract #: F41624-93-C-6009
PI: John B Bomar Jr
Title: Modelling Respiratory Gas Dynamics in the Aviator's Breathing System
Abstract: An opportunity exists to develop a comprehensive model of the Aviator's Breathing System (ABS) which mathematically describes the dynamics of respiratory gas exchange in breathing systems for high performance military aircraft. The proposed Phase I development program will include a detailed review of the literature, the synthesis and solution of a mathematical model of the ABS including the major breathing system components as well as a physiologic model of lung mechanics and respiratory gas transport. The model will be partially validated against existing data to yield a Phase I ABS model which could be employed as a tool for integrating existing physiologic knowledge and for guiding future research by explicitly identifying the new data required to more fully describe the physiologic consequences of breathing system design. Moreover, an ABS model could be employed to interpolate or extrapolate to conditions not actually measured empirically. As a life support system development tool, the ABS model will assist in elucidating the major effects of the environment and protective systems on aircrew performance, safety, and comfort. In this role, the model could be employed to show how changes to protective systems should be made to avoid adverse interactions and improve protection.

BIOLOGICAL COMPONENTS CORP.
3000 SAND HILL ROAD, BUILDING 4, STE 230
MENLO PARK, CA 94025
Phone: (315) 443-3174
Topic#: 93-139 ID#: 93WL5-205
Office: WL5
Contract #: F33615-93-C-5332
PI: Zhongping Chen, PhD
Title: Novel Biomaterials for Optoelectronic Applications
Abstract: The goal of this Phase I SBIR is to develop film processing technology to demonstrate the macroscopic properties of bacteriorhodopsin (bR) and photosynthetic reaction centers (RC's) for optical information processing. Although the true advantage of optoelectronic biomaterials is the sensor level processing capability inherent within individual molecules, it is necessary to first develop film processing techniques to realize the full potential of the biomaterials. During the six month period that is the subject of this proposal, we plan to develop high quality RC's and bR films. Films containing combinations of these molecules also will be constructed. Optical and electro-optical properties of the films developed will be characterized. Potential applications of these biomaterials as molecular electronic devices will be identified and designed. Additional applications include molecular wires & switches, biosensors, artificial retinas, automatic target recognition subsystems and robotic vision systems. During Phase II, we plan to implement designs developed in Phase I for exploiting the sensor level processing capability of these molecules.

BIOMEDICAL ENTERPRISES, INC.
TEXAS RESEARCH PARK, 14785 OMICRON DRIVE, BLDG 100
SAN ANTONIO, TX 78245
Phone: (210) 677-6042
Topic#: 93-023 ID#: 93AL -234
Office: AL
Contract #: F41624-93-C-2006
PI: W Casey Fox, PhD
Title: Endosseous Implant for Restoration of Single-rooted Teeth
Abstract: According to a NIDR survey on employed American adults' oral health, approximately 42% of those older than 65 years and 4% of those 35 to 65 years are totally edentulous. Additionally, by the age of 65, those with teeth have lost an average of ten, while those between the ages of 55 to 64 have lost nine. This tremendous number of individuals could benefit from dental implant therapy. Following tooth extraction, the edentulous ridge begins to resorb thus reducing the bone available for implant therapy. Implant placement at the time of tooth loss may allow early restoration and preserve remaining bone. Present implant designs require viable bone at the site's apex or bone replacement materials to provide initial implant stability. Apical bone requirements limit candidate sites and bone replacement materials may impede osseous healing. The proposed endosseous implants use proven masonry fastener technology to adjust their outer diameter, allowing them to contact bone from crest to apex of an extraction site, block epithelial down-growth and provide initial implant stability. This technology allows the physician to place an implant immediately following tooth extraction, thus increasing the number of patients who are candidates and minimizing the cost of the procedure.

BLAZETECH CORP.
145 HIGHLAND AVENUE
WINCHESTER, MA 01890
Phone: (617) 721-0085
Topic#: 93-165 ID#: 93WL0-065
Office: WL0
Contract #: F08630-93-C-0033
PI: Dr. N. Albert Moussa
Title: Computerized Dynamic Chemical Dispersion Model for Reactive Materials Applications
Abstract: The objective of this R & D effort is to develop a computational model that predicts reaction products and effects of reactive materials on the local environment. Release scenarios will include spill, impact and explosion, and the code will provide contamination contours from the release point as well as concentration predictions of contaminants at any selected location, as a function of time. Several example cases will be analyzed using the proposed innovative methodology.

BREWER ASSOC., INC.
215 FIRST ST.
CAMBRIDGE, MA 02142
Phone: (617) 621-3188
Topic#: 93-039 ID#: 93ES2-155
Office: ES2
Contract #: F19628-93-C-0180
PI: Michael Xifaras
Title: In-transit Visibility Technologies [Development of Model Incorporating Graphical User Interface Software Tools]
Abstract: The contractor proposes the development of an "In-transit Visibility Model". The "model's" architecture will

incorporate advanced graphical user interface software tools, object-oriented and relational data base tools, and be enveloped with applications and communication software to enable the effective and efficient integration of cargo and passenger movements initiated by DoD. The proposed in-transit visibility model in Phase I will: Enable the AMC and other DoD users to interact with the DoD transportation system and perform C2 functions for cargo and passenger movements. This tool will assist the user to logically navigate through the heterogeneous systems of AMC, MTMC, and MSC, and commercial carriers containing information about military cargo and personnel movements. Demonstrate a functional and technical integration in real time of the "data feeds" from several DoD transportation and commercial carriers' systems into a single "interactive user friendly" terminal running the proposed ITV Model software. This ITVM will be the foundation for developing in Phase II a prototype ITV system to provide real-time access, consolidation and review of planned, in-transit (en-route) and completed (terminated) cargo and passenger movements.

BRIMROSE CORP. OF AMERICA
5020 CAMPBELL BOULEVARD, SUITE E
BALTIMORE, MD 21236
Phone: (410) 931-7200
Topic#: 93-056
Office: ES3
Contract #: F19628-93-C-0133
PI: Dr. G.V. Jagannathan
ID#: 93ES3-154
Title: Pseudomorphic HEMT MMIC's by Organometallic Vapor Phase Epitaxy
Abstract: Brimrose Corporation, Phase I objective is to use the in house developed "multipolar" low temperature/low energy, mixed, ion beam assisted MOCVD process and to demonstrate that pseudomorphic HEMT structures, comparable in quality to MBE material, can be grown at low substrate temperatures. Samples will be analyzed and provided to Air Force for further evaluation. Phase II objectives are to optimize the process and grow a pseudomorphic HEMT structure. The HEMT circuit will be fabricated, tested, and compared in performance with similar devices fabricated with MBE grown material.

BUSEK CO., INC.
19 KEARNEY ROAD
NEEDHAM, MA 02194
Phone: (617) 449-9255
Topic#: 93-090
Office: PL3
Contract #: F04611-93-C-0078
PI: V. J. Hruby
ID#: 93PL3-042
Title: A Methane Arcjet Development
Abstract: A methane (CH4) electrothermal arcjet holds the potential of increased performance and longer lifetime than traditional ammonia or hydrazine arcjets. The potential drawback of CH4 arcjet is formation of soot that could cause spacecraft contamination and decreased performance. In the Phase I program we will determine the extent of soot formation and explore ways to reduce it. This will be done by testing four nozzle/anode geometries in a 2kW methane arcjet. The plasma expansion rate and nozzle temperature distribution are the major test parameters. Following the parametric tests, an eight hour duration test will be conducted with a selected anode geometry at a selected operating condition. Additionally, we will construct and test a new cathode that has the potential for unlimited lifetime and reduced cathode voltage drops, which is based on previous work with CH4 plasmas. The experimental program will be supported by concurrent numerical analysis of soot formation. This work will be performed by a subcontractor - Aerodyne Research, Inc.

C & C TECHNOLOGIES, INC.
1209 BOTETOURT GARDENS
NORFOLK, VA 23517
Phone: (804) 622-3838
Topic#: 93-015
Office: AFOSR
Contract #: FQ8671-9301355
PI: Li-Chuan Chu
ID#: 93AFO-019
Title: Integrated Intelligent Structures for Suppressing Static Aerothermoelastic Deformations and Flutter of Panels
Abstract: The ultimate goal of this project is to develop a commercial package of methodology, information, and criteria, along with documented computer programs, designing integrated intelligent panel structures to meet static aerothermoelastic deformations and flutter requirements. To accomplish this we propose to build upon the extensive experience and accomplishments of the proposed participants in Phase I. We will investigate the properties and behaviors of integrated intelligent structures consisting of advanced composite laminates, embedded shape-memory alloys (SMA) and piezoelectric laminates, and an optimal control system. Innovative concepts discussed in this proposal will be implemented and examined. Phase I activities include: (1) modeling and prediction of stability and deformations at high Mach numbers and temperatures; (2) design and analysis of optimal SMA, piezoelectric sensor and actuator configurations; (3) design and development of static

and dynamic control algorithms; (4) investigation of the interactions between supersonic aerodynamics, thermal effects, dynamic control systems, intelligent material and the non-linear response of laminated composite panels; (5) examination of weight trade-off between active (piezoelectric) and passive (SMA) materials; (6) investigation of the reliability and fail-safe design. Experimental validations will be accomplished in Phase II.

CAMBRIDGE ACOUSTICAL ASSOC., INC.
80 SHERMAN STREET
CAMBRIDGE, MA 02140
Phone: (617) 491-1421
Topic#: 92-020 ID#: 92AL-216
Office: AL
Contract #: F41624-93-C-9004
PI: JOEL M GARRELICK
Title: Assessing Environmental Structural Damage by Sonic Booms
Abstract: Assessing the environmental structural damage caused by U.S. Air Force supersonic flight operations is costly and time consuming. A contributing factor is the need for dedicated site fly-overs. These are required to measure (i) the sonic boom induced pressure field on the structure, which owing to diffraction and scattering, is site specific, and (ii) the induced response of the structure, to be related to peak stress. It is proposed that the use of structural-acoustic reciprocity techniques would allow the U.S. Air Force to circumvent this requirement and in turn reduce the associated costs. Such techniques have been used successfully for other structural-acoustic applications, for example the shock response of ships to underwater explosions. With this approach, a vibration source substitutes for the fly-over and microphones and accelerometers substitute for stress measurements. Digital post processing of the measured signals allows for the simulation of virtually arbitrarily shaped free field booms. The approach is valid for the seismic response of the structure, e.g., to sonic boom-coupled Rayleigh waves as well as for the direct effect of the overpressure on its surface.

CAMBRIDGE RESEARCH & INSTRUMENTATION
21 ERIE STREET
CAMBRIDGE, MA 02139
Phone: (617) 491-2627
Topic#: 93-082 ID#: 93PL1-284
Office: PL1
Contract #: F29601-93-C-0065
PI: Peter Miller
Title: Electrically Tunable Fabry-Perot Spectral Filter
Abstract: Frequency-agile Fabry-Perot etalons have been built using the electro-optic actin of noematic and ferro-electric liquid crystals to tune the pass wavelength. Also, techniques exist for constructing liquid crystal elements in 1-D and 2-D arrays. The combination of these technologies would yield spatially addressable, tunable spectral filter elements useful for wavelength-domain optical signal processing. These devices would be compact, rugged, and require very low drive power. However, present commercial and research etalons exhibit unacceptably low finesse ($F <= 20$) and poor throughput in the visible range. In Phase I, we propose to build an etalon using liquid crystal material, and to assess those factors which limit the optical performance of practical 1-D and 2-D arrays in the visible and near-IR. Also, reliable spectral tuning and characterization of the array elements must also be demonstrated. Other concerns include the well-known thermal bowing of liquid crystal cells, and temperature effects of the liquid crystal tuning. These performance-limiting factors will be studied, and approaches developed for implementation in Phase II. We will also characterize the etalon's fitness, transmission, extinction, useful spectral range, and response time, when filled with various liquid crystal materials to determine how liquid crystal parameters (delta-n, k33, Tc) affect overall performance, and to allow use of optimum materials.

CANDELA LASER CORP.
530 BOSTON POST ROAD
WAYLAND, MA 01778
Phone: (508) 358-7637
Topic#: 93-005 ID#: 93AED-052
Office: AEDC
Contract #: F40600-93-C-0009
PI: Jeffrey A. Russel, Ph.D.
Title: Tunable High Speed Laser Illuminator and Recording System
Abstract: A new instrument for high-speed flow visualization will be developed and demonstrated. The system will be based on a high repetition rate pulsed Ti:Sapphire laser and high imaging rate camera. Laser technology, to be developed here, allows the laser to be pulsed at rates of 100-300 KHz for a duration of up to 1 msec. The Ti:Sapphire laser is tunable from 790-900 nm and with the addition of a non-linear crystal, the wavelength region will be extended to include 375-450 nm. For added flexibility we also propose to investigate a laser resonator which could alternate colors between two adjacent micropulses. Existing photography equipment allows 80 frames recording at rates of up to 1 MHz. Alternatively, current solid state cameras

can be used for imaging and storage rates of up to 12 KHz. We propose to use the proposed system for Schlieren and shadowgraph imaging. However, we also propose to investigate the possibility of using Rayleigh scattering for planar density and qualitative velocity imaging through a Rayleigh filter.

CAPE COD RESEARCH, INC.
19 RESEARCH ROAD
EAST FALMOUTH, MA 02536
Phone: (508) 540-4400
Topic#: 93-011 ID#: 93AFC-081
Office: AFCESA
Contract #: FO8635-93-C-0090
PI: MR. JOHN P. SANFORD
Title: Electrochemiluminescent Optrode for Real-time Monitoring of Pollutants
Abstract: This six-month research and development program concerns an innovative low-cost optrode device which promises to be a significant advance in the state of the art of analytical techniques for detecting pollutants in water at part per billion concentrations. The novel instrument is based upon the use of electrochemiluminescence as a sensitive technique for detecting trace levels of organics such as benzene, xylene, and TCE. Due to the unique nature of the sensing element, pollutants will be able to be detected over a large-scale area. The Phase I program concentrates on the development of stable, accurate sensing elements for long-term operation. The device's capabilities will be evaluated under laboratory conditions. A prototype instrument will be designed and built to demonstrate the capabilities of the sensor.

CAPE COD RESEARCH, INC.
19 RESEARCH ROAD
EAST FALMOUTH, MA 02536
Phone: (508) 540-4400
Topic#: 93-145 ID#: 93WL5-333
Office: WL5
Contract #: F33615-93-C-5376
PI: Francis L Heohan
Title: UV-curing Ceramer Adhesives for Aircraft Battle Damage Repair of Transparencies
Abstract: A new UV-curing ceramic-modified silicone resin is proposed which can be rapidly cured to tough and optically clear resins. The proposed research explores the feasibility of modifying conventional silicone resins with UV-curable silicate ceramic precursors to produce a new class of semi-vitreous materials for Aircraft Battle Damage Repair (ABDR) of canopies. The polymer-modified ceramics or ceramer adhesives are designed to cure without evolving volatile by-products and with a minimum of bondline shrinkage and void formation. The UV-curing reaction is not inhibited by ambient oxygen or moisture which significantly simplifies field level bonding operations. The ultimate objective of the program is to develop an easily processed adhesive possessing high adhesion to the thermoplastics used in aircraft transparencies, optical clarity, and superior adhesion retention over a wide range of temperatures. In the proposed study, the methodology for preparing these novel ceramic hybrids will be developed and their ability to be cured into clear and adherent materials demonstrated.

CAPE COD RESEARCH, INC.
19 RESEARCH ROAD
EAST FALMOUTH, MA 02536
Phone: (508) 540-4400
Topic#: 93-148 ID#: 93WL6-014
Office: WL6
Contract #: F33615-93-C-2376
PI: R. SCOTT MORRIS
Title: Novel Solid Polymer Electrolyte for Solid State Batteries
Abstract: Solid state batteries offer potentially greater energy density than conventional nickel cadmium batteries and, when perfected, will lower satellite launch costs and increase satellite lifetimes. Unfortunately, persistent problems with electrolyte conductivity and stability have limited the development of these devices. The proposed research seeks to demonstrate a new electropolymerizable solid polymer electrolyte with improved chemical stability and ionic conductivity. This effort will entail the synthesis and testing of novel polymer electrolytes and comparison of their performance with conventional polymer electrolytes.

CENTER FOR REMOTE SENSING
P.O. BOX 9244
MCLEAN, VA 22102
Phone: (703) 848-0800
Topic#: 93-35A ID#: 93PL4-093
Office: PL4
Contract #: F19628-93-C-0200
PI: SUMAN GANGULY
Title: Inogram Scaler

Abstract: This proposal sets forth a plan to analyze and archive ionosonde data. Large amounts of ionosonde data have been collected and are still being collected in analog form. We propose to design and develop a scanner which will accept these analog data, interpret them and finally archive the ionospheric information in a systematic manner. During Phase I, we develop the algorithm for ionogram interpretation using 2-D raster data. We demonstrate the effectiveness of algorithm using simulated data. We also design the necessary hardware for the complete system. Construction and integration of the complete system will be undertaken during Phase II.

CERACON, INC.
1101 N. MARKET BLVD., SUITE 9
SACRAMENTO, CA 95834
Phone: (916) 928-1933

Topic#: 93-171
Office: WL0
Contract #: F08630-93-C-0040
PI: Ramas V. Raman, Ph.D.

ID#: 93WL0-148

Title: An Innovative Processing Approach to Evaluate the Effect of Texture on Heavy Metal Properties

Abstract: The control of texture in heavy metals has the potential to improve dynamic properties' performance. A novel powder metallurgy process will be used to produce controlled microstructure in tantalum and molybdenum materials. The Ceracon forging process will be used to produce fine grained tantalum and molybdenum materials having both texture and isotropic texture. The role of oxygen will also be investigated for its effect on microstructure and formability. Material produced using this full density process will be tested for dynamic mechanical properties in collaboration with Lawrence Livermore National Laboratory. The data on texture-property relationship developed in Phase I, will be compared with a broader data base, available from LLNL, on the effect of other methods of processing Ta plate material. Recommendations will be made to the Air Force on the material and optimum texture level for Phase II studies.

CERAMIC COMPOSITES, INC.
1110 BENFIELD BLVD
MILLERSVILLE, MD 21108
Phone: (410) 987-3435

Topic#: 93-151
Office: WL6
Contract #: F33615-93-C-2320
PI: E.L. "TED" PAQUETTE

ID#: 93WL6-217

Title: Combined Cycle Engine Variable Area Nozzle Development

Abstract: High speed combined cycle propulsion systems have several subsystems in common including the need for a method through which the exhaust nozzle area can be varied to meet the range of altitudes and velocities within a given systems' flight envelope. The extremely high temperatures and limited material cooling media available for advanced engine systems combined with lightweight propulsion system needs makes the use of high temperature composite materials, ceramic matrix composites, (CMC's) very attractive for extreme temperatures and demanding performance conditions that a variable area nozzle must meet. The required mechanical motions of a variable area nozzle makes the development of ultra high temperature lubricant systems extremely important to the reliable function of a CMC variable area nozzle. Ceramic Composites, Inc. has proposed a Phase I demonstration experiment that addresses key CMC and lubricant or tribological performance issues. Ho pivoting nozzle component tests at temperatures up to 1500 degrees C will be performed in an existing ceramic kiln to demonstrate feasibility of a hot CMC variable area nozzle. Phase II will address complete variable area nozzle design and various subcomponent development activities which will lead up to a connected pipe engine test with a prototype variable area nozzle.

CERAMIC COMPOSITES, INC.
1110 BENFIELD BLVD
MILLERSVILLE, MD 21108
Phone: (301) 261-8373

Topic#: 93-153
Office: WL6
Contract #: F33615-93-C-2321
PI: E.L. "TED" PAQUETTE

ID#: 93WL6-189

Title: Ceramic Composite Combustor Cans for Expendable Turbine Engines

Abstract: A microwave-assisted chemical vapor infiltration (CVI) process is proposed as a low cost method for fabrication of ceramic composite components for expendable turbine engines. In Phase I, optimum processing parameters for a small scale reactor (4" diameter reaction zone and 2.6 kW microwave power source) will be defined and a small scale (3" outer diameter, 0.8" thick) C/SiC/SiC combustor cans will be fabricated for rig testing. A preliminary production cost assessment will be based upon processing time required to fabricate these test articles. A scaled-up reactor that will be used in Phase II to fabricate 12-13" diameter annular and radial outflow combustors will be designed.

CF TECHNOLOGIES, INC.
ONE WESTINGHOUSE PLAZA, SUITE 200
HYDE PARK, MA 02136
Phone: (617) 364-2500

Topic#: 93-103 ID#: 93PL6-004
Office: PL6
Contract #: F04704-93-C-0002
PI: John M. Moses

Title: Design and Demonstration of a Closed Loop Multifunctional Precision Parts Cleaning Machine

Abstract: Chlorofluorocarbon (CFC) solvents have been unique in their ability to effectively clean parts from manufacturing operations, and a drop-in solvent substitute is yet to be found. Replacement solvents for these ozone layer depleting substances (OLDS) have not been shown to be equally effective across the broad range of contaminants that must be removed. In this project, CF Technologies, Inc. (CF TECH), will complete the design of a cost effective, environmentally acceptable cleaning machine that will incorporate a variety of substitute solvents and cleaning techniques in order to clean strategic guidance system components. The project will consist of engineering studies, full scale feasibility demonstrations and the completed detailed design. Engineering studies will be used to determine the specific cleaning requirements for strategic guidance system components and the overall design requirements for the process. Full scale demonstrations will be used to determine the feasibility and performance of system components. The development of a non CFC-based parts cleaning process will have applications within several commercial sectors, such as the computer, electronics and aircraft industries.

CFD RESEARCH CORP.
3325 TRIANA BLVD
HUNTSVILLE, AL 35805
Phone: (205) 536-6576

Topic#: 93-151 ID#: 93WL6-148
Office: WL6
Contract #: F33615-93-C-2369
PI: MR MATTHEW THOMAS

Title: ATR/Scramjet Engine Critical Component Development

Abstract: Development of combined Air-Turbo-Rocket (ATC)/Scramjet component technology suitable for numerous USAF propulsion missions is proposed. Preliminary component design will focus on attaining fully throttleable boost and sustain thrust, vehicle speeds from Mach 0 to 8, and range as required. Activities during Phase I include: (1) Generator of an ATR/Scramjet system and component analysis methodology by combining the most advanced modeling features of the WPAFB and MICOM ATR codes with RAMSCRAM (NASA LeRC scramjet design and analysis code); (2) Implementation of vehicle/mission trajectory analysis (WPAFB UTRAJ code) to support propulsion system component design; (3) Preliminary assessment of critical ATR/scramjet propulsion component interactions including: (a) Scramjet Operation (inlet, combustor, nozzle); (b) Off-the-Shelf (OTS) Turbomachinery Components for use in the ATR; and (c) Gas Generator Propellants. Phase II will focus on analytical/experimental assessment of the critical ATR/scramjet components. Phase III could culminate in USAF procurement of a minimum weight and cost prototype ATR/Scramjet propulsion technology suitable for implementation into low earth orbit launch vehicles and/or next generation tactical or strategic missiles.

CFD RESEARCH CORP.
3325 TRIANA BLVD
HUNTSVILLE, AL 35805
Phone: (205) 536-6576

Topic#: 93-151 ID#: 93WL6-167
Office: WL6
Contract #: F33615-93-C-2323
PI: MR S. ALAN SPRING

Title: Ramburner Fuel Injector for Endothermic Fuels

Abstract: For sustained high speed flight (Mach 3-6), recent studies have shown that endothermic fuels are required to cool aircraft systems. Such a cooling system would deliver fuel to the ramburner in varying amounts of liquid and gaseous phases. This project proposes to experimentally investigate and develop an innovative dual-phase fuel injector prototype suitable for crossflow injection in ramburners. The fuel injector will be selected based on the following criteria: 1. Liquid spray atomization; 2. fuel penetration/distribution for liquid, gaseous, and combined liquid/gaseous fuel injection; 3. susceptibility to plugging/clogging; and 4. design complexity. In Phase I, design concepts will be screened at ambient conditions using isothermal bench-scale tests. The liquid-phase fuel will be simulated using water and the gas-phase fuel will be simulated using CO2. The best designs will be isothermally tested in an existing Integral Fuel Injector/Flameholder (IFF) to show their overall feasibility. In Phase II, the best designs from Phase I will be tested in a combustion rig, under ramburner conditions, using endothermic fuels. The Phase II tests will document the performance of the new injectors under realistic conditions. If successfully demonstrated, the prototype will be tested and evaluated in a turbo-ramjet engine demonstrator in Phase III.

CHANG INDUSTRY, INC.
1925 MCKINLEY AVE. SUITE F
LA VERNE, CA 91750
Phone: (999) 990-9596
Topic#: 93-174 ID#: 93WL0-164
Office: WL0
Contract #: F08630-93-C-0042
PI: Or. Yu-Wen Chcing
Title: Passive Millimeter Wave Imaging
Abstract: Passive 94 GM, imaging with high angular resolution technique is proposed. Two dimensional computer simulation will be provided together with hardware antenna design. Data will be collected using existing hardware.

CHARLES RIVER ANALYTICS, INC.
55 WHEELER STREET
CAMBRIDGE, MA 02138
Phone: (617) 491-3474
Topic#: 93-017 ID#: 93AFO-035
Office: AFOSR
Contract #: FQ8671-9301375
PI: Dr Alper K. Caglayan
Title: A Neural Expert Approach to Self Designing Flight Control Systems
Abstract: Current flight control system (FCS) design approaches rely on linearized models, tuned to specific modes/configurations of the aircraft and employ gain scheduling for flight regime coverage. The disadvantages of techniques include a long trial-and-error design process, a lack of adaptability to on-line variations, and poor robustness to uncertainties. An artificial neural network approach eliminates these shortcomings by providing the ability to approximate non-linear mappings arbitrarily close, a not only rapidly adaptable and on-line learning solution, but a productivity improvement in the off-line design of FCSs, and implementation efficiency on the emerging neural computers. Here, we propose to develop a neural architecture for a self-designing FCS which can continuously optimize performance and accommodate changing mission requirements and anomalies such as failures and damage. In particular, we propose to develop a specialized inverse model for trim, ART based aircraft parameter identification, and Hopfield based optimizer for perturbation control. In addition, we plan to investigate the feasibility of adding FCS and ANN design heuristics into an on-line knowledge based expert system. Finally, we propose to evaluate feasibility using a high performance aircraft simulation by evaluating the performance about a flight condition.

CHARLES WILLIS & ASSOC., INC.
709-B WEST ABRAM STREET
ARLINGTON, TX 76013
Phone: (817) 261-1863
Topic#: 93-013 ID#: 93AFC-201
Office: AFCESA
Contract #: FO8635-93-C-0118
PI: CHRISTOPHER D. BASHAM, AI
Title: Development of a Bare Base Planning Module
Abstract: The design and layout of the bare base requires the assimilation and analysis of data from several sources of guidance. Without full consideration of this guidance, bare base planning may become time-consuming and inconsistent. The development of personal computer based bare base planning model would significantly improve the process of establishing an operational bare base. A computer modeling developed and structured for field development would simplify and expedite bare base planning and would help to minimize the time between conceptualization and operation of a bare base. The research proposed for Phase I work would first identify user requirements to enable program utility and products to become effective tools for field employment. Planning parameters will be established which will define program flexibility and allow analysis and incorporation of site specific factors. Planning modules will be developed which will reflect bare base development priorities both in terms of mission accomplishment and in terms of impact on other planning modules. Planning factors will be identified for each planning module and interrelationships between each planning module will be delineated and incorporated into software programs in an input/output model format. Specific input requirements for certain planning modules would be structured to be delivered as output data from interrelated planning modules. The final product from Phase I development is expected to be a software program which would produce a narrative listing of facility requirements, concerns, and developmental sequence for a generic bare base layout. The model would be structured in the delineation of planning parameters to reflect varying levels of flexibility to allow mission and planning variances to accommodate site specific characteristics/requirements. Phase II will work to develop software to translate the narrative requirements and concerns produced by Phase I research into graphic modeling.

CHEMAT TECHNOLOGY, INC.
19441 BUSINESS CENTER DR #139
NORTHRIDGE, CA 91324
Topic#: 93-144 ID#: 93WL5-316
Office: WL5
Contract #: F33615-93-C-5352

Phone: (213) 857-8030 PI: Haixing Zheng
Title: Scl-gel Deposition of Active Coatings on Aluminum Alloys
Abstract: The sol-gel process has been found to be good surface pretreatment of aluminum alloys. The sol-gel derived coatings with the necessary thickness, strength, adhesion and morphology can function as adhesive bonding on corrosion protection layers. Active, inorganic anhydrous coating is deposited on aircraft grade structure aluminum alloys by two sol-gel approaches. The coatings will be characterized with regards to chemical composition, morphology, thermodynamic stability, hydrolytic, corrosion resistance and bondability. Coating influence on metallic alloy properties such as fatigue effects will be evaluated, and the effect of the sol-gel process on the environment will be determined.

COGENTEX, INC. Topic#: 93-045 ID#: 93ES3-055
VILLAGE GREEN, SUITE 5, 840 HANSHAW RD. Office: ES3
ITHACA, NY 14850 Contract #: F30602-93-C-0145
Phone: (607) 266-0363 PI: Tatiana Korelsky
Title: Automated Software Documentation Using Linguistically-based Text Generation
Abstract: Linguistically-based text generation techniques will be used to automate the generation of software documentation from CASE tools. Two types of software documentation are typically produced: (l) formal documentation describing the structure, interfaces, data types and other mathematical properties of software, and (2) semantic documentation describing the meaning and purpose of software components and actions. Our automation of formal documentation will make use of data about software structure obtainable from CASE tools. Semantic documentation will require either a specialized domain (either by application domain or by system type) or additional structured input from users. The modularity of our proposed text generator design and the linguistic sophistication of our underlying language model will allow the production of fluent, professional-quality documentation from a wide variety of information sources (different CASE representations or user input), The proposed documentation generator framework will use text planning and grammatical knowledge to produce more fluent generated text than is possible with template-based approaches and have less need for augmentation by manually created free text. By decreasing the reliance on manual documentation we will guarantee better consistency between software documentation and program code via the specifications which guide the production of code.

CONCEPTUAL MINDWORKS, INC. Topic#: 93-023 ID#: 93AL -135
1753 GRANDSTAND Office: AL
SAN ANTONIO, TX 78238 Contract #: F41624-93-C-2002
Phone: (210) 520-0777 PI: Harold Longbotham
Title: Nystagmus Data: Non-linear Signal Processing & Non-linear System Theory
Abstract: An observer of a continuously moving visual scene has induced a reflexive eye movement called nystagmus. Nystagmus signals are termed optokinetic (vestibular) if induced by visual stimulation (head rotation or other stimulation of the vestibular system). These responses are important in flight and play an important role in spatial disorientation and the generation of various illusions of motion. The two responses are also important medically. Optokinetic responses are useful in the detection of central nervous system disorders and vestibular nystagmus induced by whole body rotation or caloric stimulation is used to evaluate the vestibula-ocular reflex. In Phase I there will be two items of interest. The first involves signal processing, avenues for improving the filtering of this data by current OS (order statistic) techniques will be explored and other techniques for filtering will be explored (wavelets, morphology, fuzzy logic, and neural networks). Second, the development of a non-linear system theory for application to biological signals like the nystagmus will be investigated. These items should be of use to the military for selection, classification, and retention of pilots and by the commercial world for diagnosis of the eye/ear system.

CONTAINERLESS RESEARCH, INC. Topic#: 93-137 ID#: 93WL5-111
735 CARRIAGE WAY Office: WL5
DEERFIELD, IL 60015 Contract #: F33615-93-C-5336
Phone: (708) 374-1723 PI: Paul C Nordine
Title: Silicon Nitride Fibers by Laser Chemical Vapor Deposition
Abstract: Laser chemical vapor deposition (LCVD) silicon nitride fiber growth is proposed, to make fibers which have the

strength and oxidative stability required for advanced high temperature structural applications. This method has been demonstrated to yield continuous, high strength fibers of materials such as boron, silicon, and others, with diameters in the range 10-30 microns, tensile strengths up to 7 GPa (10 6 psi), and high modulus. Preliminary experiments have demonstrated silicon nitride fiber growth but further research is required to determine conditions for making the fibers with superior properties. The LCVD process grows fibers by deposition at the hot spot created by a focussed laser beam. It can yield fibers with extremely uniform properties, e.g., +/- 5% in tensile strength, which result in part from a unique control mechanism. The fiber automatically grows to a position near the laser focal point where the growth rate equals the fiber pulling rate, maintaining a reproducible and constant fiber growth temperature if the fiber pulling rate is kept constant. The same mechanism supports economical design and operation of fiber production reactors. LCVD growth of continuous, small diameter (10-40 microns), high strength (> 7 GPa = 10 6 psi tensile strength), stoichiometric and/or chemical composition-controlled silicon nitride fibers will be developed and optimized.

COVALENT ASSOC., INC.
10 STATE STREET
WOBURN, MA 01801
Phone: (617) 938-1140
Topic#: 93-148 ID#: 93WL6-018
Office: WL6
Contract #: F33615-93-C-2336
PI: DR VICTOR R. KOCH
Title: New "Supercapacitor" Materials Prepared by Sol-gel Techniques
Abstract: The U. S. Air Force requires capacitors with both high gravimetric and volumetric energy densities for bridge power applications. While aqueous RuO*x*-based capacitors, currently being developed for the Strategic Defense Initiative, have excellent burst power capability, they are extremely expensive. In this proposal we suggest exploring non-toxic, inexpensive metal oxides as new non-aqueous "supercapacitor" materials which are known to possess a high pseudocapacitance. During Phase I these materials will be synthesized and configured into parallel plate capacitors. Electrochemical impedance spectroscopy will be used to assess both the dielectric and pseudocapacitance as well as the charge transfer resistance. Capacitors comprising these new materials will be charged to a variety of voltages and cycled galvanostatically at room temperature.

CPU TECHNOLOGY, INC.
47212 MISSION FALLS COURT, FREMONT
FREMONT, CA 94539
Phone: (510) 226-8844
Topic#: 93-158 ID#: 93XRX-126
Office: XRX
Contract #: F33615-93-C-1360
PI: Scott Smith
Title: Development of an Advanced Avionics Processor
Abstract: Problem: All of the currently defined Instruction Set Architectures (ISAs) are faced with obsolescence. The 1750A has fallen behind in the areas of performance and amount of addressable memory. Newer processors meet today's requirements but have no clear path for avoiding obsolescence in the future and necessitate the abandonment of the existing support software base. Objective: Develop an ISA that will remain competitive and compatible for over 256 generations and will support the existing 1750A software base. The ISA will be implemented with the development of a high performance, multi-issue, multi-generational microprocessor. Approach: Phase I involves modeling the 3 inventions and simulating them using proprietary design environment to apply concepts. Model other functions and simulate as necessary in order to perform trade-offs. Generate specifications derived from work. Phase II involves generating and verifying a fully operational model of a high performance microprocessor based on the ISA through system simulation of the SEAFAC suite and other diagnostics. Phase III includes the detailed design and prototyping of the microprocessor.

CREARE, INC.
P.O. BOX 71
HANOVER, NH 03755
Phone: (603) 643-3800
Topic#: 93-055 ID#: 93ES3-143
Office: ES3
Contract #: F19628-93-C-0085
PI: Thomas J. Jasinski, Ph.D.
Title: Advanced Gas Injector for MOCVD Reactor
Abstract: Metalorganic chemical vapor deposition (MOCVD) of III-V semi-conductor thin films will be improved through the development and application of unique gas injection hardware. The innovative hardware utilizes the vertical showerhead-type reactor configuration. It will enable for the first time detailed and active control over the transport of reactants to the surface of the substrate wafer, including the distribution of both flow rate and composition. This control will foster low cost/high yield

reactor scale-up to larger diameter wafers. The injector can also enable effective control actions to realize the potential of "Intelligent Processing of Materials" (IPM). The new hardware can be retrofit into existing MOCVD reactors. The Phase I project will test a simplified version of the injector in an MOCVD reactor to demonstrate that the user can exert firm control over reactant transport and the cause-and-effect relationship for growth of the thin film. The Phase I injector design will be supported by detailed computational modeling of the fluid flow and heat/mass transfer within the reactor. In this way, the injector can be designed to complement, and perhaps overcome, the global transport characteristics of the reactor. Comparison of experimental and modeling results will put us in an excellent position at the start of Phase II to design a prototype injector with full capabilities.

CREARE, INC.
P.O. BOX 71
HANOVER, NH 03755
Phone: (603) 643-3800

Topic#: 93-065
Office: PL1
Contract #: F29601-93-C-0143
PI: MR. W. D. STACY

ID#: 93PL1-074

Title: A Low Cost Compressor for Spacecraft Cryocoolers

Abstract: The objective of the proposed project is to reduce by more than an order of magnitude the cost of reliable and contamination-free hermetically sealed compressors for long life Stirling and Pulse Tube Cryocoolers for spacecraft. State-of-the art compressors use unlubricated flexure bearings and non-contact seals to eliminate contamination and wear, approaches requiring expensive high precision manufacturing and assembly. They use linear motors which are expensive and heavy and require accurate non-contact position sensing and complex and sophisticated electronic controls to manage displacement and vibration cancellation. The inexpensive compressor proposed for Stirling and Pulse Tube cycle spacecraft cryocoolers makes use of design approaches and manufacturing technology proven by decades of mass produced industrial and commercial products. The diaphragm compressor provides nearly isothermal gas compression processes well suited to Stirling and Pulse Tube cycle thermodynamics. In Phase I the compressor design process will be developed and documented, a typical implementation will be analyzed, and a responsive machine design geometry will be synthesized. Fluid inventory management, lubrication effectiveness, seal leakage, windage losses, and vibration will be assessed to demonstrate feasibility of the concept for satisfying demanding spacecraft requirements. Manufacturing costs will be estimated and a final report prepared detailing all Phase I findings.

CREARE, INC.
P.O. BOX 71
HANOVER, NH 03755
Phone: (603) 643-3800

Topic#: 93-065
Office: PL1
Contract #: F29601-93-C-0108
PI: JOHN McCORMICK

ID#: 93PL1-117

Title: Miniature Compressor for Low Capacity Reverse Brayton Cryocooler

Abstract: This proposal addresses the development of a miniature centrifugal compressor, a critical component for a low capacity, vibration free, long life cryocooler. Key features of the development include innovative fabrication methods to produce a unique rotor and impeller that allows the machine to achieve necessary speeds for good performance. The machine is intended for use in spaceborne cryocoolers where input power to the system is limited to about 100 watts. The compressor will be used in a reverse Brayton cycle in which the turbomachines run in high speed gas bearings. This configuration has the advantage that vibrations are negligible - an important consideration for IR sensors. Furthermore, the system is component oriented, allowing the flexibility in integration with sensor systems. The successful development of this device enables the practical use of 0.5w - 2w at temperatures between 40K and 100K. Phase I consists of analysis and trade studies to produce a preliminary design and predict performance of the compressor and the cycle. In Phase II, a prototype device will be designed, fabricated and tested.

CREARE, INC.
P.O. BOX 71
HANOVER, NH 03755
Phone: (603) 643-3800

Topic#: 93-104
Office: PL6
Contract #: F04704-93-C-0005
PI: Dr. Javier Valenzuela

ID#: 93PL6-044

Title: Electrochemical Manufacture of Metal Laminations

Abstract: An improved process is needed for the manufacture of SFIR stator and rotor laminations/cores used in missile guidance

41

systems. Poor dimensional control and costly secondary deburring and finishing operations are problems with the present photo-etching and stamping fabrication methods. We propose to develop an electrochemical manufacturing technique which has the potential for producing burr-free features with better dimensional control than can be achieved by present methods. Metal cutting will take place at, or near, room temperature, leaving no heat affected zone in the finished parts. Material strength and magnetic properties will, thus, remain unaffected. In Phase I we will demonstrate the feasibility and establish the performance potential of the proposed process through a series of proof-of-concept tests. In Phase II we will design and fabricate a prototype machining system.

CREARE, INC.
P.O. BOX 71
HANOVER, NH 03755
Phone: (603) 643-3800
Topic#: 93-129
Office: WL4
Contract #: F33615-93-C-3407
PI: Mr Christopher J. Crowley
ID#: 93WL4-118
Title: Compact Thermal Energy Recovery System for Fighter Aircraft
Abstract: We propose an innovative system for recovering waste heat from fighter aircraft. The system will tap the large quantities of available heat from the engine or airframe and use a Rankine cycle to generate useful power for the aircraft electrical systems. The innovative aspect of this power conversion system is to use Creare's advanced heat exchanger and turbomachinery component technology to minimize the size and weight of the energy recovery system. Creare has developed very compact, high flux heat exchangers which can be used to gather heat from the structures as well as to boil and condense the working fluid. Creare has also developed turbomachinery for aerospace applications in which advanced fabrication techniques enable small size and high efficiency, and non-contact bearings give simplicity and high reliability. By integrating these advanced technology components, we will develop a lightweight, small volume, power conversion system for the fighter aircraft.

CREARE, INC.
P.O. BOX 71
HANOVER, NH 03755
Phone: (603) 643-3800
Topic#: 93-147
Office: WL6
Contract #: F33615-93-C-2317
PI: DR MICHAEL G. IZENSON
ID#: 93WL6-097
Title: Integral Cooling Microsystem for Higher Power Electronics Modules
Abstract: Future multi-chip modules (MCMs) for radar and power electronics will need to operate at higher power densities. However, current power electronics modules are approaching operating limits due to the limited effectiveness of conventional techniques for heat removal via backside cooling. We propose to develop a micromachined cooling system for multi-chip modules which can enable dramatically higher power levels to be achieved by directly cooling the power-producing junctions on the chips. The system has no moving parts and is completely self-contained within the multi-chip modules. Therefore, the proposed system is simple to integrate into aircraft systems. In Phase I, we will demonstrate feasibility through proof-of-concept tests, thermal analysis, and design integration.

CREATIVE OPTICS, INC.
360 STATE ROUTE 101, SUITE 201
BEDFORD, NH 03110
Phone: (603) 472-6686
Topic#: 93-027
Office: AL
Contract #: F41624-93-C-6026
PI: James C. Kilian
ID#: 93AL -123
Title: An Innovative Approach to Man-ATR Interaction
Abstract: Requirements on ATR (Automatic Target Recognition) performance are becoming more stringent. ATR systems are expected to detect, classify, recognize, and even identify, threats with greater accuracy and in less time over an increasing range of scenarios. Similarly, operators in manned combat systems also suffer from pressures for better target acquisition performance in the face of an overwhelming workload. In response, one of the more pressing questions regarding future combat systems is whether or not a symbiotic relationship between a human operator and ATR process can exceed the target acquisition performance of either, and simultaneously reduce the total workload on the human operator. Creative Optics, Inc. is proposing to define a strategy for Man-ATR interaction that meets these needs.

42

CRYOGENIC ENGINEERING LABORATORY
589 LEFT FORK ROAD
BOULDER, CO 80302
Phone: (303) 444-4743

Topic#: 93-092 ID#: 93PL3-016
Office: PL3
Contract #: FO4611-93-C-0087
PI: David E. Daney

Title: Design of Prototype Storage and Delivery Device for Cryogenic Solid Hydrogen Propellants

Abstract: The proposal is for an engineering design, including detailed shop drawings, of a cryostat for the condensation of solid hydrogen from the vapor phase, for storage with a heat leak of less than 10-4 watts/grams of hydrogen, and with controlled expulsion to a combustion chamber at greater than atmospheric pressure. The cryostat uses liquid helium as a coolant, and has a transparent freezing chamber and radiation shields with shutters to allow visual inspection of the morphology of the solid hydrogen. Delivery of the solid hydrogen to the combustion chamber is achieved by extruding the hydrogen with a plunger. The capacity of this freezing chamber is in excess of the 13cc needed to hold 1 gram of solid hydrogen.

CRYSTAL ASSOC., INC.
15 INDUSTRIAL PARK
WALDWICK, NJ 07463
Phone: (201) 612-0060

Topic#: 93-140 ID#: 93WL5-226
Office: WL5
Contract #: F33615-93-C-5372
PI: G M Loiacono

Title: Preparation and Characterization of KNbB2O6 for UV and IR Non-linear Optical Applications

Abstract: KNbB2O6 (KNB) is a new non-linear optical material with high optical transparency, large birefringence, large non-linear optical coefficients and is non-hygroscopic. This material is an excellent potential substitute for LBO in high average power non-linear optical devices, like third harmonic generation of Nd:YAG and in OPO applications. Small crystals have been grown using the TSSG method, but application of the HTS growth method should produce large, high optical quality material at reasonable costs. The development of a growth technique and optimization of the solvent system will permit production of large single crystals, which offer an alternative to LBO and BBO.

CRYSTAL SYSTEMS, INC.
27 CONGRESS STREET
SALEM, MA 01970
Phone: (508) 745-0088

Topic#: 93-021 ID#: 93AFO-009
Office: AFOSR
Contract #: FQ8671-9301373
PI: Dr Chandra P Khattak

Title: Development of Materials for Spectral Hole Burning Applications

Abstract: Spectral hole-burning materials offer an extra degree of freedom to enhance optical memory and processing for computer and processor architecture. The understanding of these materials is limited and they have not been utilized in practical applications. Typical candidate materials are doped crystals with magnetic spins on dopant ion and non-magnetic host crystal ions. In addition to these properties it is important to grow the chosen material in single crystal form in large enough sizes for devices. Based upon the available information, two materials have been selected, viz., Eu:Y2Si05 and Eu:YAG. During the proposed Phase I program the crystal growth characteristics of the materials will be identified and potential use evaluated. Eu:Y2Si05 has exhibited dephasing time (822 us) whereas Eu:YAG is chosen, in spite of Al ions in the host, because it is a well-understood host crystal. Based upon data, a program will be developed to evaluate materials for hole-burning applications.

CRYSTALLUME
125 CONSTITUTION DRIVE
MENLO PARK, CA 94025
Phone: (415) 324-9681

Topic#: 93-021 ID#: 93AFO-052
Office: AFOSR
Contract #: FQ8671-9301358
PI: William Phillips

Title: CVD Diamond Doped with Transition Metals and Rare Earths for Persistent Spectral Hole Burning Memory Applications

Abstract: The advent of broadly tunable laser sources raises the possibility of using the phenomenon of spectral hole burning of inhomogeneously broadened absorption lines to implement optical information storage via wavelength addressed holographic recording and readout. CVD diamond suggests itself as a candidate for this application because several color center absorption lines, severely broadened by the inhomogeneous strain fields typical of CVD diamond, have been demonstrated {1} to exhibit spectral hole burning at 77K. In the proposed work we will examine CVD diamond doped with transition metals and rare earths for inhomogeneously broadened absorption lines that may be placed conveniently to the tuning range of diode lasers. Doping will be accomplished in a hot filament reactor equipped with a dopant vapor source. Optical characterization of samples will

take place at the Large Bangap Semi-conductor Laboratory at the University of Pittsburgh, under the direction of Professor W.J. Choyke.

CRYSTALLUME
125 CONSTITUTION DRIVE
MENLO PARK, CA 94025
Phone: (415) 324-9681
Topic#: 93-135 ID#: 93WL5-069
Office: WL5
Contract #: F33615-93-C-5341
PI: M D Drory
Title: Diamond-coated Fibers for Polymers Matrix Composites
Abstract: The feasibility of diamond-coated fibers for polymer matrix composites will be explored. The poor thermal conductivity of polymers restricts the use of these materials as structural components under thermal loading. This problem will be addressed in collaboration with General Dynamics by incorporating CVD diamond-coated fiber mats in polymer matrix composites. The composite thermal properties will be measured to assess the benefits of a high thermal conductivity diamond coating for this application. The mechanical properties of diamond-coated monofilaments will also be determined.

CSA ENGINEERING, INC.
2850 WEST BAYSHORE ROAD
PALO ALTO, CA 94303
Phone: (415) 494-7351
Topic#: 93-015 ID#: 93AFO-047
Office: AFOSR
Contract #: FQ8671-9301353
PI: Warren Gibson
Title: Structural Integrity of Intelligent Materials and Structures
Abstract: Intelligent materials open new avenues to improve performance, reliability and longevity of future aerospace vehicle structures by allowing the structural materials themselves to become active elements for multiple system functions. However, the application of intelligent materials and structures has been inhibited because the effects of microstructural interactions between intelligent and host material elements have not yet been well characterized. The objective of the proposed research is to develop predictive models of these local phenomena to enable analytical assessment of their effects on material and structural integrity. The research plan involves: (1) extension of existing micromechanical models of composite material behavior to include descriptions of intelligent material elements, (2) development of new models to assess the geometrically non-linear effects of embedded elements in composite material systems, (3) application of numerical models of crack propagation behavior to predict growth of damage in intelligent composites, and (4) design of experiments to validate the analytical models and to further explore damage propagation in intelligent material systems. The analytical models developed under this effort will be implemented in widely used software systems (e.g. Mathermatics, NASTRAN).

CSA ENGINEERING, INC.
2850 WEST BAYSHORE ROAD
PALO ALTO, CA 94303
Phone: (415) 494-7351
Topic#: 93-070 ID#: 93PL1-162
Office: PL1
Contract #: F29601-93-C-0174
PI: JOSEPH R. MALY
Title: Missile Payload Vibration Isolation
Abstract: Reducing the dynamic response of spacecraft during launch will have a number of benefits in their design, test, and operations phases and will allow mission performance, rather than launch survivability, to be the primary goal of structural design. This SBIR proposes to integrate an isolation system into the interface adaptor between the launch vehicle and the spacecraft. Besides the increase in launch survivability, a payload isolator system will also reduce cost, weight, and size of some spacecraft components; allow isolator redesign rather than spacecraft requalification; relieve launch vehicle loads; and relax dynamic coupling design, analysis and test requirements. Phase I of this effort will develop concepts and provide supporting analysis for an innovative payload/adaptor isolation system. Phase I will determine which passive and/or active vibration control technologies are most applicable. A preliminary design of a payload/adaptor/isolation will be formulated, and analysis will be performed to determine its effectiveness. Work will also begin on a comprehensive spacecraft isolator design procedure. Phase II will demonstrate system effectiveness for representative payload and launch vehicle configurations through critical component hardware testing coupled with additional analysis and simulation. Phase III will provide a adaptor/isolator system for flight demonstration.

CYBERDYNAMICS, INC.
1860 EMBARCADERO RD., SUITE 155
PALO ALTO, CA 94301
Phone: (415) 856-6188

Topic#: 93-116
Office: WL2
Contract #: F33615-93-C-1243
PI: Frederick Beckner

ID#: 93WL2-108

Title: Validation of CAD Models Used in Electromagnetic Signature Prediction

Abstract: CAD models of aircraft are currently used to predict synthetic radar signatures for use in target identification. These CAD models may contain modeling errors which cause errors in the predicted signatures. Signature validation by comparison with measured UHRR signatures will reveal the existence of model errors, but does not specifically identify the portion of the model in error. The proposed research will determine the feasibility of validating CAD models by comparison with a photographic database obtained under strictly controlled conditions. The CAD model image, and the scaled photographs are compared using the blink microscope technique which makes differences in the two images readily apparent.

CYGNUS LASER CORP.
P.O. BOX 1679
DUVALL, WA 98019
Phone: (206) 788-5862

Topic#: 93-084
Office: PL1
Contract #: F29601-93-C-0071
PI: Jeff W. Pierce

ID#: 93PL1-100

Title: Diode Pumped Optical Parametric Oscillator

Abstract: Many applications exist for tunable laser light in the mid-infrared region of the electromagnetic spectrum, located in the wavelength range from 1.3-5 microns. Cygnus Laser Corporation intends to conduct a rigorous research and development program in the field of compact, highly reliable, tunable single-frequency optical parametric oscillators. We believe we have already demonstrated the feasibility in principle of a diode pumped OPO. Hence during Phase I, we will construct a diode pumped noncritically phase matched optical parametric oscillator.

D-STAR ENGINEERING
5 B DAISY DRIVE
SEYMOUR, CT 06483
Phone: (203) 881-0074

Topic#: 93-158
Office: XRX
Contract #: F33657-93-C-2326
PI: S. Paul Dev

ID#: 93XRX-089

Title: Electro-turbo-compound Ceramic Diesel Engine for Propulsion and Power

Abstract: This proposal suggests the development of an uncooled ceramic two-stroke-cycle oil-free turbocharged diesel engine with a flywheel-integrated motor/generator for the engine and a shaft-integrated very-high-speed motor/generator for the turbocharger. The engine is to provide mechanical power output for propulsion, while the turbogenerator provides conditioned electric power for on-board electronics, etc. Three-way transfer of electrical power between engine, turbocharger and a battery is used to aid cold-starting, reduce turbo-lag and store excess power. The turbocompound engine, with other proposed innovative features, will offer high power, compact dimensions, low weight, reduced complexity and cost, low fuel consumption, multi-fuel ability and low emissions of pollutants, noise and infrared. The proposed Phase I activities include benchmarking and conceptual development, evaluation and selection of enabling technologies, preliminary design & layout, cycle analysis and optimization, projection of engine performance, evaluation of benefits to user vehicles, projection of technical feasibility for the engine and financial feasibility for the project.

D. C. RICH COMPANY
5820 119TH AVE EAST
PUYALLUP, WA 98372
Phone: (206) 841-6317

Topic#: 93-011
Office: AFCESA
Contract #: FO8635-93-C-0106
PI: DANIEL C. RICH

ID#: 93AFC-049

Title: Investigation in the Use of Glass Marbles as a Coalescing Medium in Oil/Water Separators

Abstract: Petroleum products from fueling and maintenance facilities are common pollutants in surface and groundwater. Most oil/water separators currently in use are coalescing plate interceptor (CPI) units made up of closely-spaced plastic plates submerged in the waste stream. Microscopic oil droplets coalesce on the surfaces of the plates, then collect and rise to the water surface in the plate chamber. The system works effectively but maintenance is expensive because the fragile plate-and-spacer assemblies must be removed for cleaning and are susceptible to damage. This proposal is to study the possibility of using low-coat glass marbles as a coalescing medium in place of plastic plates. Glass attracts oil as well as plastic does, and the

interstices between the marbles will allow water to flow through. Oil will coalesce on the surface of the marbles and rise to the water surface for removal. The marbles may be cleaned of sediment by agitating the filter bed with a water or air hose and pumping off the sediment in suspension. The marbles need not be removed and may be re-used indefinitely, saving considerably on the cost of maintenance.

DAEDALUS ENTERPRISES, INC.
P.O. BOX 1869
ANN ARBOR, MI 48106
Phone: (313) 769-5649
Topic#: 93-176 ID#: 93WL0-184
Office: WL0
Contract #: F08630-93-C-0044
PI: DAVID 5. DILWORTH
Title: Infrared Spectral Imaging Radiometer (IRSIR)
Abstract: The proposed effort analyzes five spectral imaging radiometer concepts with the goal of developing an infrared spectral imaging radiometer (IRSIR) for use in high performance aircraft. The desired performance characteristics for this IRSIR are: high optical throughput, a small physical package, and 0.5 to 1.0 percent spectral resolution over the 0.2 to 12 um range at frame rates of 30-100 frames per second. Two of the concepts use innovative staring spectrometer designs and collect the spatial/spectral image in a single frame. The other three scanning approaches create the spatial/spectral image by combining multiple image frames. The five methods vary greatly in innovation, performance, and technical risk. The research has four objectives: (A) Identify the IRSIR applications and design goals; (B) Perform a preliminary analysis of the five concepts; (C) Select the best candidate approach; and (D) Determine the feasibility of the candidate approach. A design concept will be developed for the best candidate for Phase II prototyping. It is expected the Phase II implementation and testing will confirm that the proposed IRSIR will collect unique target signature data permitting discrimination of targets and backgrounds from an aircraft platform.

DANIEL H. WAGNER ASSOC., INC.
894 ROSS DRIVE, SUITE 205
SUNNYVALE, CA 94089
Phone: (408) 745-1800
Topic#: 93-075 ID#: 93PL1-266
Office: PL1
Contract #: F29601-93-C-0053
PI: Jeffrey R. Sachs
Title: Improved Modeling of Bauschinger Effects in Plastic Flow
Abstract: The research and development proposed here closes the gap on an important area of simulating material behavior. In particular, anisotropic models of the Bauschinger effect have been neglected in the development of hydrocodes for the simulation of viscoplastic behavior, in spite of its importance to both impact and penetration phenomena. The Bauschinger effect is fundamental to the proper simulation and design of ballistic weapons and defenses, space structures, and many other critical metal alloy structures subject to impacts. The proposed work will demonstrate the feasibility of implementing a new model of the Bauschinger effect. The new viscoplastic constitutive model will be based on well established internal variable representations of non-linear kinematic hardening which properly account for the rate and temperature dependence, large straying kinematics, and suitable correlational stress rate. The model will be implemented using an existing Lagrangian finite element package, and will be verified by comparing simulation predictions with experimental results for several common experimental configurations.

DAVID DUBBINK ASSOC.
1147 NINTH STREET
LOS OSOS, CA 93402
Phone: (805) 528-4161
Topic#: 93-023 ID#: 93AL -081
Office: AL
Contract #: F41624-93-C-9008
PI: David T. Dubbink
Title: Multi-media ISIS (Interactive Sound Information System)
Abstract: The Interactive Sound Information System (ISIS) developed by the proposer has demonstrated effectiveness as a means of presenting information about noise management issues to decision makers. This project would create a prototype for a substantial upgrade of the current system; improving quality and usability of the system. It would incorporate animation and video capabilities needed to describe three dimensional problems such as are involved in flight operations. The user interface would be improved making it more graphical and intuitive. Surveys of existing and future user groups would assist in pinpointing needs and opportunities. The project builds from existing ISIS techniques, adding off-the-shelf multi-media components. The work objective summarizes to "better presentations" with "less presenter effort".

DCW INDUSTRIES, INC.
5354 PALM DRIVE
LA CANADA, CA 91011
Phone: (818) 790-3844
Topic#: 93-184 ID#: 93WL9-007
Office: WL9
Contract #: F33657-93C-2231
PI: Dr. David C. Wilcox
Title: Numerical Simulation of Three-dimensional Hypersonic Turbulent Flows
Abstract: Advanced experimental methods that can provide quantitative flow field imaging data in hypersonic flows are required for the development of advanced hypersonic technology and the validation of computational fluid dynamic codes. To satisfy this requirement an evaluation of potential improvements in the electron-beam fluorescence technique used for planar flow visualization in the 20-inch hypersonic wind tunnel at Wright Laboratories will be conducted. Methodologies for improvement in the measurement of the density, rotational and vibrational temperature of molecular nitrogen will be evaluated in the context of the existing electron-beam source, imaging system, and wind tunnel operating characteristics. Essential features of the electron-beam fluorescence technique to be used in the evaluation include: beam propagation characteristics, spatial resolution, simulation of fluorescence spectra and signal level, and minimum measurement time requirements to maintain an acceptable signal-to-noise ratio. Recommendations will be provided on the design characteristics of an appropriate electron-beam fluorescence imaging system and associated image processing schemes to obtain quantitative flow field measurement of gas density and temperature in a hypersonic flow.

DECISION DYNAMICS, INC.
8601 GEORGIA AVENUE, SUITE 806
SILVER SPRING, MD 20910
Phone: (301) 565-4040
Topic#: 93-013 ID#: 93AFC-199
Office: AFCESA
Contract #: FO8635-93-C-0119
PI: LOUIS EDWARD ALFELD, DSC
Title: Bare Base Planning
Abstract: The proposed software program will provide the USAF with a quick, efficient, and cost-effective means for "bare base" planning. The program is designed around two advanced software technologies. The first is the use of mapping programs to provide a representation of the physical environment surrounding the base location. Computer-based maps will function as entry points to the database that defines the physical environment. The second technology is the use of "smart" graphic icons to represent facility requirements. Each icon will contain all of the information needed to define the facility and its relationship to other facilities. The user need only "point and click" to place or move icons on the map. The program will also generate a construction schedule, materials list, equipment requirements and manpower skills needed to build the air base.

DECISION SCIENCE ASSOC., INC.
10980 POPLAR FORD TRAIL
MANASSAS, VA 22110
Phone: (703) 754-0284
Topic#: 93-040 ID#: 93ES2-038
Office: ES2
Contract #: F19628-93-C-0148
PI: Jacob W. Ulvila
Title: Cost Benefit Analysis Tool for C4 Information Modeling
Abstract: DSA proposes to develop a cost benefit analysis tool for command, control, communications, and computer (C4) systems. This tool will incorporate the best combination of methods from the fields of economic analysis, decision analysis, and optimization into a comprehensive functional/economic methodology to perform C4 cost benefit analysis. Phase I consists of three tasks. In Task 2, we will identify the important factors that contribute to the Air Mobility Command's evaluation of C4. In Task 2, we will demonstrate the top level implementation algorithms and specify the tool architecture. In Phase II, we will produce a prototype software tool to fully implement the methodology developed in Phase I.

DECISION SCIENCE ASSOC., INC.
10980 POPLAR FORD TRAIL
MANASSAS, VA 22110
Phone: (703) 754-0284
Topic#: 93-161 ID#: 93XRX-008
Office: XRX
Contract #: F33657-93-C-2325
PI: Jacob W. Ulvila
Title: A Decision Support Tool for Development Planning
Abstract: Decision Science Associates, Inc. (DSA) proposed to develop and demonstrate an automated decision support tool for long-range acquisition planning. This tool will support the assessment and prioritization of system concept alternatives and supporting technologies based on military operational requirements. Phase I consists of 3 tasks. In Task 1 we will identify the

(47)

important aspects of the long-range acquisition process that should influence the development of a decision tool. These include: missions, organizational dynamics, technologies, interdependencies, management style, database integration, and others. In Task 2, we will examine the strengths and weaknesses of feasible analytical approaches and recommend the one to develop into a decision support tool. At a minimum, we will examine Quality Function Deployment (QFD), Multiattribute Utility (MAU) analysis, and a hybrid approach that combines features of both QFD and MAU. In Task 3, we will develop and demonstrate a working prototype system. At a minimum, this system will: provide rank ordering of system concepts and technologies; permit the user to query the system to trace a technology linkage back to user requirements, and incorporate pre-programmed features to facilitate sensitivity analyses.

DEMACO
5 MARAINE COURT
CHAMPAIGN, IL 61821
Phone: (217) 356-4197
Topic#: 93-116 ID#: 93WL2-098
Office: WL2
Contract #: F33615-93-C-1246
PI: Shung-Wu Lee
Title: Automatic Target Recognition (ATR) Research
Abstract: We propose to develop a general purpose computer code for calculating the scattering from antennas on an aircraft, which is described by a CAD file. The scattering contribution will include both the passive structure mode and active irradiation mode, calculated by a hybrid of a high-frequency ray technique and a rigorous finite element technique. The proposed code will be made compatible with the existing ATR computation tools, so that it can be integrated into the existing package.

DISPLAYTECH, INC.
2200 CENTRAL AVENUE
BOULDER, CO 80301
Phone: (303) 449-8933
Topic#: 93-016 ID#: 93AFO-067
Office: AFOSR
Contract #: FQ8671-9301302
PI: Kenneth Edmund Arnett
Title: Development of Ferroelectric Liquid Crystals with Enhanced Non-linear Optical Properties
Abstract: A new class of non-linearly active materials has been developed: x(2) ferroelectric liquid crystals (x(2) FLCs). This class has several advantages over other classes of materials such as crystals or poled photochromic polymers. FLCs readily form low-light-loss polar films of any thickness; no poling is necessary; the FLC non-linear susceptibility is intrinsically thermodynamically stable; and FLC optical non-linearity can be engineered by chemical synthesis or mixing. X(2) FLC films formed into low-light-loss waveguides can be used in devices such as low half-wave electro-optic modulators, frequency doublers, and high-gain optical parametric amplifiers. During Phase I, we will blend new mixtures from x(2)-enhanced liquid crystal monomers synthesized at Displaytech and the University of Colorado and measure their frequency doubling coefficient deff of X-1.06um light at Lawrence Livermore National Lab or their electro-optic modulation coefficient r. Anticipated values for deff exceed 2pm/V, while anticipated values for r exceed 20 pm/V. To reduce temperature sensitivity, light loss, dielectric loss, and possible drive field dependence of x(2)-FLCs, we will also investigate x(2)-FLC polymeric and dipolar glass systems. In Phase II, optimized x(2) FLCs will be synthesized, characterized, and incorporated into first generation waveguide devices such as electrooptic modulators and near infrared diode laser frequency doublers.

DONALD J. GEISEL & ASSOC., INC.
6 JORDAN COURT
CLIFTON PARK, NY 12065
Phone: (518) 371-5029
Topic#: 93-011 ID#: 93AFC-069
Office: AFCESA
Contract #: FO8635-93-C-0093
PI: DONALD J. GEISEL
Title: Thermally Accelerated Vacuum Extraction and Bioremediation
Abstract: In situ Thermal Accelerated Vacuum Extraction and Bioremediation processes are proposed for feasibility study. Both Vacuum Extraction and Bioremediation are acceptable means for in situ soil decontamination; however, both have practical limits related to soil temperature. Vacuum Extraction is limited to semi-volatiles, a vapor pressure/molecular weight criteria, while bioremediation is vastly affected by soil temperature and climatic variations. The project objective is to study the effectiveness of a novel, low-cost and hazard-free technology to warm soil for the purpose of accelerating these known and acceptable processes without the use of radio frequency or electricity. Specific objectives are to: 1. Improve an existing model for the flow of heat from the company's proprietary energy source. 2. Study how heat flow varies with air flowing through the soil using the proposed warming technology. 3. Estimate the per-ton cost for a field site remediation application.

DQDT
3101 MADERA COURT
LA COSTA, CA 92009
Phone: (619) 944-6785
Topic#: 93-117
Office: WL3
Contract #: F33615-93-C-1236
PI: Dr Scott R. Powell
ID#: 93WL3-047
Title: Application Specific Electronic Design Synthesis
Abstract: The overall goal of this program is the development of tools for rapid synthesis of common classes of electronic systems. DQDT's approach is to create generators which synthesize application specific VHDL descriptions of systems from high-level specifications. These generators can then leverage readily available and constantly improving VHDL based CAD tools for simulation, gate level synthesis, and mask level synthesis. By synthesizing at the VHDL level, these generators have complete independence from the chip fabrication vendor, the CAD tool vendor, and the hardware platform. Also, the inherent technology retargeting and upgrading capability of this approach shields new systems from early obsolescence due to rapidly improving chip technology. Through a novel use of standard VHDL constructs, the proposed generators offer the user control over the amount and degree of bit-level pipelining and over the implementation style of arithmetic elements. These features significantly broaden the speed-area solution space beyond existing gate level logic manipulation methods. A library of generators will be created which are oriented around common signal processing functions such as filters, convolvers, adaptive operators, and transforms. The end product of the Phase I effort will be a complete implementation of a digital filter generator tool to evaluate the efficacy of the proposed approach.

DRAGAN ENGINEERING
15528 HIGH KNOLL RD
ENCINO, CA 91436
Phone: (818) 995-7431
Topic#: 93-011
Office: AFCESA
Contract #: FO8635-93-C-0123
PI: ALEXANDRA DRAGAN
ID#: 93AFC-154
Title: Biofiltration of Volatile Organic Compounds Emitted at Industrial Waste Treatment Plants for Paint-stripping Operations
Abstract: The proposed research will study the effectiveness of biofiltration for the purification of air streams from industrial waste treatment plants for Air Force paint-stripping operations. The investigation will entail: removal efficiencies for the target contaminants, methylene chloride and phenol, the choice of the packing media in terms of energy consumption, its ability to support microorganisms and to operate efficiently under fluctuating pollutant concentrations. The final report will include a preliminary assessment of the economic feasibility and effectiveness of biofiltration for the removal of methylene chloride and phenol.

DYNA EAST CORP.
3201 ARCH STREET
PHILADELPHIA, PA 19104
Phone: (215) 386-4884
Topic#: 93-164
Office: WL0
Contract #: F08630-93-C-0031
PI: Dr. William J. Flis
ID#: 93WL0-006
Title: Improved Analytical Techniques for Fragment Warheads
Abstract: We propose to develop an improved analytical model for predicting the velocity and direction of fragments projected by an explosive warhead. The model will account for the metal acceleration history, unsteady effects, curvature, internal voids, and end effects (explosive pressure release). The model will be validated by comparisons with experimental data and hydrocode corruptions.

DYNAMIC SYSTEMS, INC.
635 SLATERS LN., SUITE 100
ALEXANDRIA, VA 22314
Phone: (703) 684-4060
Topic#: 93-036
Office: ES2
Contract #: F19628-93-C-0137
PI: Paul McDaniel
ID#: 93ES2-045
Title: Definition of Parameters and Development of Algebraic Model to Enhance Logistics Supportability
Abstract: The purpose of this project is to define supportability parameters for Air Force C3I systems and construct algebraic models that facilitate design, development, and producibility decisions and ensure appropriate attention to supportability issues throughout the life cycle of the system. During this project supportability variables will be identified that are common to more than one supportability element and to both equipment and logistics system design. These common variables will require trade studies and the quantification of associated variables. The objectives of this project will be achieved through the performance

of five tasks. They are: (1) Identify the significant supportability elements and factors and their relationships as they relate to Operational Supportability (So), Inherent Supportability (Si), and Achieved Supportability (Sa); (2) derive the key drivers of the supportability elements identified and generate a database of supportability factors and a dependency network; (3) identify the mathematical relationships between elements and drivers; (4) identify required trade studies; and (5) finalize the So, Si, and Sa models.

DYNAX CORP.
103 FAIRVIEW PARK DR
ELMSFORD, NY 10523
Phone: (914) 592-0202

Topic#: 93-009 ID#: 93AFC-029
Office: AFCESA
Contract #: F08635-93-C-0101
PI: KIRTLAND P. CLARK, PHD

Title: Improved Formulation of Fire Fighting Agents for Hydrocarbon Fuel Fire

Abstract: AFFF agents are the most efficient fire fighting foams to extinguish hydrocarbon fuel fires, but have limited effectiveness for extinguishing rolling fuel fires and limited burn-back resistance. AFFF agents have also poor biodegradability caused by the high content of fluorocarbon surfactants. This is a proposal to develop parameters for an AFFF agent replacement with improved fire performance and less impact on the environment. Parameters to be established include chemical, physical, toxicological, and environmental parameters under static and dynamic conditions. A dynamic fire test will be proposed in collaboration with the Air Force or another branch of the military. Acceptable classes of potential components for the AFFF agent replacement will be defined. Specific components to be selected for formulation and evaluation purposes will include commercially available as well as developmental chemicals and polymers. Based on evaluation data to be generated which justify the recommended parameters, a fire fighting agent formulation with enhanced fire fighting capability and less impact on the environment will be developed in Phase II of AF93-009.

ECODYNAMICS RESEARCH ASSOC., INC.
P O BOX 9229
ALBUQUERQUE, NM 87119
Phone: (505) 843-7445

Topic#: 93-011 ID#: 93AFC-061
Office: AFCESA
Contract #: F08635-93-C-0085
PI: PATRICK J. ROACHE

Title: High-accuracy Robust Groundwater Flow and Transport Codes for Environmental Engineering

Abstract: Computational algorithms and codes will be tailored specifically to the Air Force's needs in groundwater flow and pollutant transport as required in Environmental Engineering. The project will build heavily on previous and ongoing Ecodynamics work for Sandia Laboratories on the Waste Isolation Pilot Plant (WIPP) project and on proposed work for the U.S. Army Waterways Experiment Station. Robust, efficient, high-accuracy algorithms embodied in user-friendly codes will be developed for 2-D and 3-D time-dependent flows, including single phase miscible flows, multi-phase flows, NAPL, and DNAPL, and saturated and unsaturated (vadose-zone) conditions. Algorithmic innovations (even in Phase I) will include facilitation of grid convergence tests in multiple domains; automatic error estimation; correct treatment of transmissivity factors for unconfined aquifers; multigrid algorithms; a convenient formulation of variable density flow equations in terms of freshwater head; boundary-fitted coordinates; temporal high-order particle tracking; efficient, accurate and robust calculation of contaminant transport (advection, dispersion and diffusion) in (possibly) fractured porous media, and up-scaling of properties in strongly heterogeneous media. The codes will be designed for modern workstations with the highest standards of verification and Quality Assurance. Installation and tutorials will be provided to Tyndall AFB.

EIC LABORATORIES, INC.
111 DOWNEY STREET
NORWOOD, MA 02062
Phone: (617) 769-9450

Topic#: 93-007 ID#: 93AFC-011
Office: AFCESA
Contract #: F08635-93-C-0088
PI: TIMOTHY L. ROSE

Title: In situ Polymerization of DNAPLS

Abstract: EPA has targeted DNAPLS, dense nonaqueous phase liquids, which sink below and leak into the groundwater as a major problem inhibiting successful cleanup of contaminated groundwater. The proposed program will develop a containment process, dubbed GRIP, for Gamma (Y) Ray Induced Polymerization, which will convert the organics in the DNAPLS to an intractable, insoluble solid fixed in the soil. GRIP will treat a variety of chemical pollutants, does not require physical contact between the radiation source and the pollutant, is low temperature, and leaves no residue from the processing. The Phase I work

will subject samples of trichloroethylene (TCE) to GRIP to determine the effect of total dose, dose rate, and of solids and benign chemical additives to TCE samples. The polymerization rate, degree of polymerization, and solubility of polymer will be determined. A 10 cubic foot test cell designed to model a DNAPL will be subjected to GRIP using radiographic sources. The results will be used to model the system to determine the optimal source size and placement for scaled up treatments planned in Phase II. In Phase II, this technique will be combined with the use of cone penetrometers for on-site treatment of DNAPLS.

EIC LABORATORIES, INC.
111 DOWNEY STREET
NORWOOD, MA 02062
Phone: (617) 769-9450
Topic#: 93-135
Office: WL5
Contract #: F33615-93-C-5354
PI: Stuart F Cogan
ID#: 93WL5-071
Title: Variable Emittance Devices
Abstract: The development of thin film devices and coatings with an electrically tunable emittance in the 3-5 microns and 8-12 microns spectral bands is proposed. The emittance modulation is based on reversible electrochromic switching in thin films of crystalline transition metal oxides. On electrochemical reduction, these oxides undergo a broadband IR optical transition between that of a wide band gap, transparent semi-conductor and a reflective metal. Electrochromic device structures are proposed which allow these oxides to be electrically switched in a continuously adjustable manner between low and high emittance states in response to a low voltage DC signal. Innovation in the use of materials that combine electrical conductivity with either high infrared transmittance or absorption (emittance) and allow the fabrication of flexible device structures are described. The objective of the Phase I effort is to fabricate and characterize prototype variable emittance devices embodying the innovations proposed. The Phase II effort would expand the base of materials and device designs with the objective of optimizing emittance switching in structures suitable for applications on military platforms.

EIDETICS INTERNATIONAL, INC.
3415 LOMITA BLVD
TORRANCE, CA 90505
Phone: (310) 326-8228
Topic#: 93-123
Office: WL4
Contract #: F33615-93-C-3810
PI: Brian Kramer
ID#: 93WL4-057
Title: Evaluation of Flight Agility/Departments Characteristics with a New Multi-axis Text Rig
Abstract: The evaluation of lateral/directional stability departure boundaries for combat aircraft in preliminary design has historically been based on the knowledge of certain static aerodynamic coefficients. For aircraft operating at high angles of attack and high yaw and roll rates, these criteria are inadequate. A new criteria including yaw and roll rate dependent terms has been developed by Eidetics. To use the criteria, numerical values for these terms must either be calculated or determined from specific dynamic wind tunnel tests covering a large matrix of independent variables such as angle of attack and sideslip, oscillation frequency and amplitude, etc. An alternative to determining the values of these individual parameters is an innovative experimental approach utilizing a multi-axis rotational wind tunnel apparatus. This experimental technique would directly determine the stability and controllability tradeoffs of a model in "constrained flight" in response to control inputs from conventional surfaces, thrust vectoring, or other aerodynamic control effectors such as forebody vortex control. Phase I will determine the feasibility and utility of such a device, and, if judged to be beneficial, an operational apparatus would be designed, built and demonstrated in Phase II.

EIDETICS INTERNATIONAL, INC.
3415 LOMITA BLVD
TORRANCE, CA 90505
Phone: (310) 326-8228
Topic#: 93-128
Office: WL4
Contract #: F33615-93-C-3600
PI: Steven M. Mosher
ID#: 93WL4-061
Title: Automated Forces for Air Combat Simulation
Abstract: Accurate simulation of force level air-to-air and air-to-ground combat, requires an accurate, comprehensive, tactical environment. Historically, simulation development has focused on increasing the fidelity of single ship operations. Only recently have high fidelity force level air combat simulations been fielded. Unfortunately the number of manned players is still too low to accurately represent a real world tactical environment. For example, a typical attack package in Desert Storm involved more than a dozen friendly aircraft, not including support aircraft, such as tankers, AWACS, jammers and defense suppression. If we add a capable air threat, we are clearly beyond the capability of the best force level simulation available today. In short,

we have very accurate simulation of aircraft operating in very unrealistic tactical environments. There are two approaches to increasing the number of participants in an interactive simulation: networking and developing automated forces, or computer controlled adversaries and friendlies. In this particular offering Eidetics proposes to increase the fidelity of force level by designing, developing and integrating a full ensemble of automated threats and friendlies.

ELECTRIC PROPULSION LABORATORY, INC.
1040 SYNTHES AVENUE
MONUMENT, CO 80132
Phone: (719) 481-4411
Topic#: 93-090 ID#: 93PL3-009
Office: PL3
Contract #: FO4611-93-C-0099
PI: Dr. Graeme Aston

Title: Methane Arcjet Sooting Evaluation and Control

Abstract: Methane propellant has the potential for achieving arcjet performance levels close to that of pure hydrogen. However, methane has a cryogenic storage density six times that of hydrogen, and a 100 C higher minimum storage temperature requirement. A Phase I program to determine the extent of the sooting problem in arcjets operating with methane propellant is described. Three approaches to minimizing sooting are presented, and specific experiments to validate these approaches are described for performance in Phase I. These experiments utilize proprietary EPL arcjet hardware and extensive supporting test facilities, rather than an electrode simulation which might result in ambiguous phenomena. The success of this proposed Phase I program would enable development in Phase II of a methane arcjet with superior performance to existing space storable arcjet propellants.

ELECTRIC PROPULSION LABORATORY, INC.
1040 SYNTHES AVE
MONUMENT, CO 80132
Phone: (719) 481-4411
Topic#: 93-094 ID#: 93PL3-022
Office: PL3
Contract #: FO4611-93-C-0090
PI: Dr. Graeme Aston

Title: High Performance Insulators for Electric Propulsion Engines

Abstract: New technology, high performance insulators are critical to improved electric propulsion engine operation and lifetime. Little work has been done on investigating the advances in dielectric materials as they apply to existing and future electric propulsion engine applications. Furthermore, the lack of suitable high temperature insulator materials is preventing the development of very high power, high thrust electric propulsion engines. A Phase I program is proposed to experimentally subject a wide range of existing and new candidate insulator materials to a high temperature, high flux plasma environment for accelerated degradation testing. It is anticipated that the data obtained from the proposed experiments will be the first of its kind available. The demonstration of insulator materials capable of surviving the hostile Phase I test environment will identify specific materials and fabrication techniques to enable a new class of high performance insulators to be developed and rigorously tested during Phase II in an actual electric propulsion engine.

ELECTRO OPTIC CONSULTING SERVICES
18198 AZTEC CT.
FOUNTAIN VALLEY, CA 91708
Phone: (714) 964-0324
Topic#: 93-087 ID#: 93PL1-941
Office: PL1
Contract #: F29601-93-C-0101
PI: DR. COLLEEN FITZPATRICK

Title: Real-time Aero-optic Flow Visualization Using the Erasable Material Bacteriorhodopsin

Abstract: Bacteriorhodopsin is a new, high speed, erasable, dynamic holographic recording material that is an ideal candidate for creating successive multiple holographic exposures in flow visualization. Bacteriorhodopsin is an organic photochromic material, sensitive to sing photon stimulation with picosecond response times. Conventional holographic aero-optic instrumentation has been extremely limited until now by the one-shot nature of silver halide materials. This has limited data taking to either a highly time- resolved single "slice" of data, or to time-averaged analysis, neither of which gives information on the time development of the flow systems. It is proposed to study the potential of using bacteriorhodopsin to create interferometric "movies" to alleviate this difficulty. With its high speed recording capabilities, its high resolution, and its erasability, bacteriorhodopsin has the potential of superseding technology that is already 20 years old. It can be easily integrated into holography systems in place of silver halide materials, with very little change in the experimental set-up. Bacteriorhodopsin has already proven useful in such contexts as: Fourier transform holography, pattern recognition architectures, and 3-D optical memories.

52

ELECTROIMPACT, INC.
2721 NE BLAKELEY
SEATTLE, WA 98105
Phone: (206) 525-2403
Topic#: 93-163 ID#: 93XRX-200
Office: XRX
Contract #: F33657-93-C-2357
PI: John Hartmann
Title: Identification and Analysis of Problem Fastened Joints on the F-15
Abstract: Fasteners are used extensively on both military and civilian aircraft structures. Stress concentrations introduced by fastener holes, the intimate contact between these materials dissimilar in nature and/or stiffness and the inherent load transfer demands placed on the fasteners themselves can all lead to problems in service. One of the critical parameters which determines the longevity of a joint's integrity is the preload with which the parts are fastened. A tight joint insures that the two parts move as one under subjected flight loads and vibrations. Fighter aircraft are particularly susceptible to problems due to the extreme flight, vibration and environmental load conditions experienced in service. Loss of preload initially results in fretting of the joint. This leads to wear of the fastener and/or the substrate material and if undetected to crack initiation and ultimate material failure. The USAF F-15 fighter will be chosen as a typical fighter aircraft for this investigation. With the assistance of McDonnell Douglas Aircraft (MDA), information will be gathered from the F-15 Depot Maintenance organization to identify which locations on service aircraft have experienced grip-loss problems in fastened components. For each problem area, the specific parameters defining the geometry and materials will be determined. Once this data collection is complete, a typical problem area will be selected for the Phase I case study. A selection criteria process will be used to determine which problem area is best suited for more detailed analysis and testing. In the Phase I case study, the service environment of the target area on the F-15 will be estimated from MDA's extensive F-15 database. An empirical case study will be performed to gain a more thorough understanding of the physical phenomenon which causes the fastened joints to lose their preload. Twenty four representative test specimens will be assembled per the existing installation specifications. These specimen will be tested under flight load, vibrational and harsh environmental conditions. Nut torque, joint preload and microstructual analysis will be performed at various time intervals during these tests.

ELECTRONIC DECISIONS, INC.
1776 EAST WASHINGTON STREET
URBANA, IL 61801
Phone: (217) 367-2600
Topic#: 93-162 ID#: 93XRX-129
Office: XRX
Contract #: F33657-93-C-2327
PI: A.J. Vigil
Title: A Radio-silent Communications System
Abstract: The present system of communication between KC-135/KC-10 tanker aircraft and receptacle-equipped receiver aircraft calls for communication based on aircraft lights. The Air Force requires a system for undetectable verbal communication between tanker and receiver from a range of 1500 meters to point blank. This document describes an approach for providing undetectable verbal tanker/receiver communication based on a recently developed low power noise signaling modulation technique called "transmitted reference noise signaling." A new wideband transmitted reference noise approach to signaling communications is made possible by acoustic charge transport (ACT) technology. The objective of the proposed Phase I program is to evaluate the feasibility of using an ACT-based noise signaling communication system to provide verbal communications under radio silent conditions during aerial refueling procedures.

ELECTRONIC SOLUTIONS CORP.
5580 LAJOLLA BLVD, SUITE 130
LAJOLLA, CA 92037
Phone: (619) 454-5781
Topic#: 92-153 ID#: 92XRX-049
Office: ASD/XRX
Contract #: F33657-92-C-2180
PI: C. A. ("AL") IRVINE
Title: IDEFO/SAINT Integrated (I/SIS) Project Proposal
Abstract: Process management is now recognized as perhaps the most significant management problem in the 1990's. Whether one looks at manufacturing systems and factory modernization or at enterprise engineering and business simplification improvements the emphasis is on the definition and description of complex systems of processes. The focus is process management. Process or "function" modeling is the foundation of process management and quantitative evaluation of proposed process designs by simulation is critically important. The I/SIS Project will integrate IDEFO (the best available function modeling and enterprise engineering method) with two levels of system simulation. It will provide direct simulation capability for IDEFO models as they are constructed using an automated modeling tool. It will also provide automated translation to one or more full scale simulation systems. Phase I will define an understandable and effective notation for adding the timing and

53

quantification information to IDEFO models that is required for simulations; specify and algorithm for translating annotated IDEFO models to SAINT (Systems Analysis of Integrated Networks of Tasks); carry out experiments in direct simulation and translation; establish the feasibility of direct simulation of IDEFO models; and demonstrate the feasibility of automatic translation of IDEFO models into SAINT.

EMCORE CORP.
35 ELIZABETH AVENUE
SOMERSET, NJ 08873
Phone: (908) 271-9090
Topic#: 93-055 ID#: 93ES3-148
Office: ES3
Contract #: F19628-93-C-0087
PI: Dr. Gary S. Tompa

Title: Development of a Large Area, High Throughput, Automated MOCVD System

Abstract: III-V compound semi-conductors are increasingly in demand for advanced electronic and optoelectronic applications. To keep abreast of the increasing demand for high speed devices, such as HEMTs or FETs, it is imperative for the III-V compound semi-conductor systems producers to make the transition from laboratory to production systems. Two main issues surrounding the epitaxial growth onto large area GaAs substrates are the layer thickness uniformity and the doping uniformity. It is important that the layer thickness of HEMT, HBT, and PET devices be uniform in order to control recess etching so that uniform threshold voltages and hence device characteristics are reproducible. The doping uniformity plays an important role in controling the transconductance, and will be studied during this work. Metal Organic Chemical Vapor Deposition (MOCVD) is best suited to cost effectively produce the required materials with high yields. A strategic advance in the development of this materials technology is the shifting from 4" to 6" diameter process substrates. As yet, there is no established method for production of device structures on 6" diameter substrates. In Phase II, we will demonstrate a fully automated cassette to cassette 6" diameter wafer production capability. The Phase I and II efforts will be performed in an ENCORE high speed rotating disk vertical reactor systems, which is known to efficiently produce high quality MOCVD materials through 4" diameter substrates.

EMCORE CORP.
35 ELIZABETH AVENUE
SOMERSET, NJ 08873
Phone: (908) 271-9090
Topic#: 93-056 ID#: 93ES3-152
Office: ES3
Contract #: F19628-93-C-0098
PI: Dr. Heng Liu

Title: MOCVD Growth and Characterization of Pseudomorphic HEHT's in a High Speed Rotating Disk Reactor

Abstract: Until recently, nearly all of the major work on pseudomorphic HEMTs has been dominated by MBE technology. Low throughput is an inherent problem with MBE equipment. For this reason EMCORE proposes to use its low pressure, high speed, rotating disk MOCVD technology for the deposition of pseudomorphic HEMT structures. The technology is scaleable so that increasing the growth chamber size to accommodate growth runs of multiple 4 in. wafers should be possible. ENCORE proposes in phase I to extend our GaAs/AlGaAs HEMT technology to the pseudomorphic HEMT structure. We will examine the In fraction InGaAs layer thickness to optimize the mobility of the structure. These will be a "characterization" structure growth which has an undoped GaAs cap layer so that both 300 k and 77k Hall effect measurements may be done. Also, a sheet resistivity map of the entire wafer is generated to insure film uniformity. The initial growth runs will be done on 2 in. diameter substrates. When the process has been optimized the growths will be done on 4 in. diameter wafers. These wafers will again have the sheet resistivity map prepared. Nine samples will then be cleaved in a cross pattern. 300k and 77k Hall effect measurements will be performed to examine uniformity of mobility. The most promising 2 in. sample will be sent to our consultant for device fabrication and testing. A complete device wafer (GaAs cap layer will be doped) will be made available to the Air Force for further device processing.

ENERGY SCIENCE LABORATORIES, INC.
6888 NANCY RIDGE DRIVE
SAN DIEGO, CA 92121
Phone: (619) 552-2034
Topic#: 93-096 ID#: 93PL3-011
Office: PL3
Contract #: FO4611-93-C-0093
PI: Timothy R. Knowles, PhD

Title: High Emissivity Arcjet Anode

Abstract: Improved cooling of the anode can increase the efficiency and lifetime of arcjet thrusters. Smooth tungsten anodes have low emissivity ~0.3 that severely limits radiative cooling heat transfer can be increased 300% by improvements in emissivity, and thereby significantly increase arcjet power. Prior attempts to increase tungsten emissivity have had problems:

ceramic coatings tend to flake off under high temperature cyclic arcjet operation and surface roughening by arc and sputter texturing does not succeed on tungsten. This project will investigate a novel processing technique for texturing surfaces with small diameter fibers. The process involves the application of short fiber flock and a chemical vapor deposition coating to obtain high density, well oriented, large aspect-ratio microcavities on substrate materials such as tungsten, carbon and refractory ceramics. In Phase I, a series of carbon fiber flocked samples will be prepared and characterized to aid modeling of the infrared optical properties of flocked surfaces and to guide design. Sample tungsten surfaces will then be prepared and characterized at high temperature to assess the feasibility of the approach for arcjet anodes. Other anode materials will be surveyed and the potential benefits for arcjet propulsion will be assessed. Other potential optical and thermal applications will be surveyed. In Phase II, the process would be developed and prototype anodes would be fabricated for testing under arcjet relevant conditions.

ENERGY SCIENCE LABORATORIES, INC.
6888 NANCY RIDGE DRIVE
SAN DIEGO, CA 92121
Phone: (619) 552-2034

Topic#: 93-124
Office: WL4
Contract #: F33615-93-C-3206
PI: Timothy R. Knowles PhD

ID#: 93WL4-116

Title: Implanted Fiber Reinforcement of Laminated Composites

Abstract: Increasing the interlaminar strength of advanced composite materials will improve damage tolerance and permit use of thin gauge facesheets for ultra-lightweight structural materials. This project will investigate novel means of implanting individual fibers through the thickness of laminated composites. Such reinforcement with separate fibers extending through multiple plies is expected to offer the preferred combination of mechanical properties, in which interlaminar strength is improved without degrading the in-plane strength. The fiber implantation method, which does not involve stitching or weaving, appears to be suitable for large scale processing. It may be used also with non-weavable fibers and whiskers. Phase I effort will focus on experimentation with the process variables. Diverse fiber materials, fiber diameters, fiber lengths, and laminate forms (unidirectional and woven) will be tested. An objective is control over fiber orientation and areal density as required for interlaminar reinforcement purposes. Reinforced composite samples will be fabricated and inspected. The most promising process will be used to fabricate samples for short beam mechanical testing. Potential improvements in the damage tolerance of composite facesheets and the potential for aircraft weight reduction will be assessed. Phase 2 would develop further the leading process and scale up to fabricate and test prototype composite panels.

ENERGY SCIENCE LABORATORIES, INC.
6888 NANCY RIDGE DRIVE
SAN DIEGO, CA 92121
Phone: (619) 552-2034

Topic#: 93-187
Office: WL9
Contract #: F33657-93-C-2241
PI: Jack Chin

ID#: 93WL9-014

Title: Flocked Carbon Heat Exchanger Tubing

Abstract: This project aims to develop nonpermeable thin-guage carbon tubing with an integral radial carbon fiber brush on its outer surface for enhanced heat transfer. The carbon tubing is derived from polyimide tubing. The radial fiber structure is created by electrostatic flocking. Coatings to block hydrogen permeation and to protect against erosion are applied by chemical vapor deposition. The proposed process is suited for various guages of tubing and for various curvatures. The flocked carbon tubing my be integrated with carbon fiber preforms and processed to form an actively cooled carbon-carbon structural component for use with hot pressurized hydrogen. Phase I effort will focus on materials processing. We will investigate the carbonization of selected precursors, fiber flocking methods, and CVD coatings. Electron microscopy will be used to inspect the tubing wall and fiber attachment. Sections of flocked carbon tubing will be fabricated for thermal cycling, and measurements of permeation and the rate of erosion in hot hydrogen. Preliminary thermal analysis will model carbon-carbon heat exchanger structures with the new tubing to investigate design trades and assess the overall performance. A draft design for a Phase II prototype heat exchanger panel will be prepared. Phase II would continue process development, leading to fabrication of a prototype exchanger panel to be tested under conditions relevant to the NASP leading edge application.

ENGINEERED MEDICAL SYSTEMS, INC.
1856 LOCKHILL SELMA, SUITE 105
SAN ANTONIO, TX 78213
Phone: (210) 341-5461

Topic#: 93-023
Office: AL
Contract #: F41624-93-C-2003
PI: Jack R Maison

ID#: 93AL -223

55

Title: Compact Smart Console for HBO Chambers
Abstract: HyperBaric Oxygen (HBO) medical treatment therapy is performed on humans in pressurized chambers. The chambers are operated by a trained technician that directs the chamber systems from a console. The operator monitors the chamber parameters, the patient's physical condition and controls the electrical and mechanical systems from the console. The current state of HBO console design is a legacy from US NAVY diving systems. NAVY diving consoles are large in size and complex to operate. HBO medical facilities need a small compact computerized display and control station. The Phase I technical objective is to develop a low cost, COmpact functionally Smart and easy to use COnsole (COSCO) for HBO medical facilities. Innovations introduced for COSCO include: WINDOWS-like software to improve ease of use and operator control, full operator programmable presentation of chamber and patient data, fuzzy control system logic, artificial intelligence and/or neural networks to advice and direct chamber operation or patient treatment in emergency or unusual circumstances, high speed data compression to collect and store a video and an audio record of a treatment dive, integration of fiber optic blood gas monitoring sensors into the patient monitoring function, and hardware and software redundancy to insure uninterrupted safe operation.

ENGINEERED MEDICAL SYSTEMS, INC.
1856 LOCKHILL SELMA, SUITE 105
SAN ANTONIO, TX 78213
Phone: (210) 341-5461

Topic#: 93-023
Office: AL
Contract #: F41624-93-C-2004
PI: Jack R Maison

ID#: 93AL -224

Title: Rectangular Concrete Pressurized Room for Hyperbaric Oxygen Medical Treatment
Abstract: HyperBaric Oxygen (HBO) therapy is a proven treatment for numerous medical conditions. HBO therapy is based on the premise that oxygen at pressure greater than atmospheric provides enhanced healing. The major cost component of any HBO treatment center is the structure that contains the elevated pressure. Conventional practice has been to use steel pressure vessel technology for fabrication of HBO chambers. Accordingly, HBO chambers are cylindrical in shape. Medical HBO practitioners want rectangular rooms instead of cylindrical chambers. Patients are often frightened by the appearance of a large steel cylinder. Rectangular rooms give better space utilization and can be integrated directly into the hospital. The rectangular room cannot be economically constructed using conventional steel pressure vessel practice; but concrete offers an economic alternative. A USAF study showed cost savings potential of 70% using concrete. Commercialization of this technology awaits proof of concept. The objective of this study is to construct and test of a full size rectangular concrete pressure vessel for human occupancy (RCPVHO). The Phase I technical objective is to develop a detailed design of a full size prototype RCPVHO. Construction drawings and specifications will be prepared and a testing plan generated.

ENGINEERING CONCEPTS & SOLUTIONS
7338 S. YUKON COURT
LITTLETON, CO 80123
Phone: (303) 972-1191

Topic#: 93-167
Office: WL0
Contract #: F08630-93-C-0035
PI: John K. Reece

ID#: 93WL0-089

Title: Two-dimensional Electronically Steerable Monopulse Millimeter-wave Antenna
Abstract: The overall objective of this two-phased research effort will be the design and demonstration of a mm-wave phased array antenna with two-dimensional, monopulse beam steering capability. Phase I will be a feasibility study which will identify the critical components required for the development of a transmit and receive (T/R) module architecture, mechanical design, thermal design, fabrication and packaging methods, and power division network (PDN) topology for the extraction of three channels of monopulse information from the array antenna system. The results of this Phase I activity will be a recommendation of the components and design philosophy which will be utilized in the design and fabrication of a breadboard, monopulse beam steering MMW phased array antenna.

ENGINEERING RESOURCES, INC.
P.O. BOX 3682, BIOMASS RESEARCH CENTER HWY112
FAYETTEVILLE, AR 72702
Phone: (501) 575-4108

Topic#: 93-010
Office: AFCESA
Contract #: F08635-93-C-0100
PI: DR. E.C. CLEUSEN

ID#: 93AFC-036

Title: Production of an Environmentally Compatible Deicer from Wastes
Abstract: Current highway and runway deicers include rock salt, urea and glycols, all of which are toxic to vegetation or aquatic life or are corrosive to bridges and vehicles. In some areas, deicing runoff must be confined for subsequent treatment. Calcium

magnesium acetate (CMA) is very expensive ($650) per ton) because of the high cost of glacial acetic acid. This project will investigate a unique technology for producing acetic acid from the cellulosic fraction of municipal solid waste (MSW), which today also poses a serious threat to the environment. The technology will combine an established process for MSW gasification with an Engineering Resources process for the biological conversion of synthesis gas (CO, H2, CO2) into acetic acid. The combination results in a simple and economical process that has the potential to produce CMA for $80 per ton. Phase I of this project will involve laboratory experiments to measure reaction rates and acetic acid yields with MSW synthesis gas. Experiments will also be conducted to demonstrate CMA production by extraction of acetic acid and reaction with lime. The design and economics of a commercial facility will be projected to demonstrate economic feasibility. Phase II will include the design and operation of a continuous bench-scale unit for CMA production. A field test will be conducted to demonstrate the deicer performance. Scale-up parameters shall be developed for a pilot demonstration to be conducted in Phase III.

ENVIRONMENTAL BIOTECHNOLOGIES, INC.
P.O. BOX 371477
MONTARA, CA 94037
Phone: (415) 728-8609
Topic#: 93-008 ID#: 93AFC-021
Office: AFCESA
Contract #: FO8635-93-C-0094
PI: DOUG MUNNECKE, PHD
Title: Anaerobic Degradation of Ordnance Chemical Wastes
Abstract: Complete, efficient, and cost-effective disposal of the secondary explosives and propellants has been an ongoing problem for federal and private manufactures of ordnance containing these chemicals. The need for new disposal technology has been recently heightened by the current emphasis on waste minimization in both the military and private sectors, and by the discovery of these chemicals in groundwater at military bases and arsenals. In this proposal Environmental BioTechnologies, Inc. (EBT) with COGNIS, Inc. presents a SBIR Phase I Program for development of a highly efficient anaerobic biodegradative process for complete destruction of RDX/HMX, nitrotoluenes, a nitrobenzene and other ordnance chemicals. This proposed project will focus on biodegradation of RDX and dinitrotoluene in aqueous streams, but would be applicable in Phase II to other ordnance chemicals and contaminated soils. Additionally, this proposal will provide a plan for the implementation of this technology that should address this pressing need for the Air Force, DoD at large and private industry.

ESSEX CORP.
1040 WOODCOCK ROAD, SUITE 227
ORLANDO, FL 32803
Phone: (407) 894-5090
Topic#: 93-030 ID#: 93AL -198
Office: AL
Contract #: F41624-93-C-5006
PI: Robert S Kennedy PhD
Title: Augmentation of the Basic Attributes with Tests of Temporal Acuity
Abstract: Our industrialized society places a premium on the visually-based ability to resolve fine-spatial detail in the environment. But the perceptual demands of new aircraft display systems, and indeed the tasks of out-the-window performances (landing, low-level attack, etc.) in aviation may involve temporal acuity (e.g., motion perception) as much as spatial acuity. Further, an inability to "switch" attention and fixation rapidly from one visual display to another is more likely related to temporal than spatial visual systems and may be a major factor in the aviation "human error" component. We hypothesize that individuals differ in their temporal visual acuity and, if so, then measures which tap this capability could be predictive of success in flight training as well as aviation operational performance. There is a large literature devoted to temporal factors in vision, and there is neurophysiological evidence that independent retinol-cortical pathways are used for motion perception, flicker, and meta contrast when compared to color vision and fine-line acuity. So far as we know, there are no direct measures of temporal acuity which are used as selection criteria for pilots. In Phase I, we propose to implement a battery of such tests on a computer and determine whether performance on such tests is: (a) reliable enough to be a suitable predictor, (b) uncorrelated with other existing aptitude measures, and (c) uncorrelated with existing tests of spatial acuity.

ESSEX CORP.
9170 RUMSEY ROAD
COLUMBIA, MD 21045
Phone: (410) 730-1097
Topic#: 93-169 ID#: 93WL0-130
Office: WL0
Contract #: F08630-93-C-0038
PI: James L. Lafuse
Title: Image Synthesis System for Optical Pattern Recognition/Optical Correlation
Abstract: To avoid limitations imposed by conventional spatial light modulators in two-dimensional optical pattern

57

recognition/correlation systems, a hybrid optical-electronic system combining the throughput benefits of optical processing and accuracy of digital processing is proposed. This optical processing system is based on the Essex patented ImSyn(TM) processor which combines optical and digital integration to achieve high dynamic range. Tile proposed processor is based on a processing method that uses both phase and amplitude information to produce true complex transforms. Because the processor operates on complex data, improvements in pattern recognition performance may be achieved over traditional optical methods which use either amplitude-only or phase-only processing. The complete hybrid system can be manufactured in a small, low power, and lightweight package for use in automatic targeting of small munitions. The Phase I effort will be directed toward concept demonstration on a laboratory prototype system, development of a detailed design, and the preparation of a Phase II work plan. The Phase II effort will be to build and deliver an optical pattern recognition/optical correlation processor suitable for flight demonstration.

EXOS, INC.
2A GILL STREET
WOBURN, MA 01801
Phone: (617) 933-0022
Topic#: 93-026 ID#: 93AL -134
Office: AL
Contract #: F41624-93-C-6008
PI: Dr. Beth A. Marcus
Title: Hand Exoskeleton Haptic Display
Abstract: The proposed innovation is the development of a sensory feedback Hand Exoskeleton Haptic Display (HEHD). The objectives of the Phase I program are to study the utility of different methods of sensory display for controlling robot hands, and to develop a prototype of an HEHD that incorporates multiple modes of feedback including force feedback. EXOS has developed several prototype exoskeleton display and sensing devices including: 1) a prototype of a force reflecting exoskeleton master which reflects forces to the index finger, 2) TouchMaster which uses vibration to indicate fingertip contacts in a virtual display, and 3) the Dexterous HandMaster which uses an exoskeleton to measure joint angles. By building on our previous work in comfortable attachment, human perception, and force reflection, we will be able to complete the five primary objectives: development of a task performance specification, Determining the sensing methods employed in performing the tasks, development novel feedback methods, and construction and verification of a prototype HEHD. This will result in the preliminary design specification for a complete HEHD and the delivery of a prototype HEHD which demonstrates the feasibility of the concept.

FAIRFAX MATERIALS RESEARCH, INC.
5613 MARBLE ARCH WAY
ALEXANDRIA, VA 22310
Phone: (703) 922-4579
Topic#: 93-075 ID#: 93PL1-154
Office: PL1
Contract #: F29601-93-C-0052
PI: DR. M. S. DUESBERY
Title: Improved Modeling of Bauschinger Effects in Plastic Flow
Abstract: Existing, continuum-based models of plasticity cannot account for the Baushcinger effect and other asymmetries in plastic flow. This is because the Bauschinger effect has its origin in atomic-scale lattice defects known as dislocations. Dislocation propagation causes local shears, subject to rigid selection rules, which are not part of the continuum framework. Specifically, when obstacles to plastic flow are present, such as non-deformable dispersoids, the local dislocation density increases with deformation to satisfy compatibility conditions. On reversal of the applied stress, this excess dislocation content collapses and leads to a reduced flow stress, the classical Bauschinger effect. There are other asymmetries in plastic flow which are similarly not part of the continuum picture. The logical approach to this problem is to develop a model in terms of the fundamental defect, the dislocation. The proposed research will be aimed at a fully interacting many-dislocation numerical model, incorporating all of the lattice-based properties of dislocations. In Phase I, the model will be fully defined, and limited computer codes to demonstrate the feasibility of the project will be constructed. Particular attention will be devoted to high strain rate and low temperature conditions, and to interfacing to standard continuum methods.

FALCON COMMUNICATIONS CORP.
4035 N. 30TH ST.
COLORADO SPRINGS, CO 80919
Phone: (719) 590-9753
Topic#: 93-035 ID#: 93ES2-158
Office: ES2
Contract #: F19628-93-C-0141
PI: Paul Cook
Title: Transportable Secure Cellular Communications for C3I

Abstract: Today's DoD requires highly flexible secure communications for data and voice communications to meet the rapid response requirements to any area of the world. Tactical systems now being fielded utilize 1970's digital switching technology while the Army MSE program has upgraded this technology to include RF links, call routing, data transmission, and subscriber support features developed in the early 1980's. The commercial telecommunications industry has developed the second generation of wireless digital mobile communications technology. This emerging Spread Spectrum digital cellular technology has characteristics of importance in secure DoD applications. These characteristics include low probability of intercept, low user power consumption, soft hand-off and reduced frequency planning. These features can be combined with intelligent switch features to support the unique features required by DoD users. These switch architectures provide a capability for scaling the size of the systems to meet the requirements of the transportable systems. The modular and layered implementations provide the protocol independence necessary to support continuing system evolution to new capabilities and standards. The TSCC SBIR program will provide a proof of concept of the application of the commercial digital cellular systems to the DoD requirements for transportable secure wireless communications systems.

FARR RESEARCH
614 PASEO DEL MAR NE
ALBUQUERQUE, NM 87123
Phone: (505) 293-3886

Topic#: 93-077
Office: PL1
Contract #: F29601-93-C-0054
PI: EVERETT G. FARR

ID#: 93PL1-199

Title: A Microwave Code Combining External Coupling and Internal Circuit Response

Abstract: In the past few years, considerable progress has been made in determining the vulnerability of a circuit to microwave radiation. At the same time, much progress has been made in analyzing external coupling. What is currently lacking, however, is a general computer code that can determine the overall threat to a system, by combining the problems of external coupling, propagation on cables, and circuit analysis and damage assessment. The objective of this research will be to generate a code that handles microwave coupling and the associated circuit analysis. This code will be useful in determining vulnerability to ultra wideband signals as well. During Phase I, we will write the specifications for a general purpose code that calculates the susceptibility of an asset based on an external HPM threat. Certain parts of the code may be written in order to test algorithms. In Phase II, the actual code will be developed.

FEMTOSCAN CORP.
1834 WEST 4700 SOUTH
SALT LAKE CITY, UT 84118
Phone: (801) 966-2266

Topic#: 93-023
Office: AL
Contract #: F41624-93-C-4002
PI: Neil S. Arnold

ID#: 93AL -153

Title: Personal Chemical Warfare Agent Monitoring Device Using Gas Chromatography/Ion Mobility Spectrometry

Abstract: The need for powerful personal monitoring equipment to alert military personnel to impending chemical threats is clear. The development of sophisticated monitoring equipment which may be carried on a belt or in a pocket has largely been restricted to chemical sensors which tend to lack sufficient specificity to offer adequate protection while minimizing false alarms. The present proposal is to investigate the feasibility of a personal detection device using a combination of automated vapor sampling technology, gas chromatography and ion mobility spectrometry using a novel, recently introduced personal IMS device. The merit of this approach is the ability to offer specific detection information for a large set (20-100) of potential threat agents as well as background interferants. High speed GC/IMS, as potential threat agents as developed by FemtoScan Corp in collaboration with the University of Utah and Graseby Ionics Ltd., currently offers the only combined chromatography/spectroscopy approach capable of hand portable operation and the extension of this technology to a personal detection device would offer unparalleled detection technology potentially capable of detecting and identifying ug/m3 amounts of threat agents in complex backgrounds with a real-time response.

FERMIONICS CORP.
4555 RUNWAY STREET
SIMI VALLEY, CA 93063
Phone: (805) 582-0155

Topic#: 93-080
Office: PL1
Contract #: F29601-93-C-0061
PI: Yet-Zen Liu

ID#: 93PL1-283

Title: Low Dimensional 2-5 Micron Semi-conductor Lasers

Abstract: Theoretical study of Auger recombination in HgCdTe quantum wells, quantum wires, and quantum dots with mid-IR

lasing wavelength (2-5 um) is proposed to compare with Auger coefficient in double heterostructure with bulk active layer. The benefit of this study is broad since the band structure of HgCdTe is similar to other III-V compounds among which there may also be a candidate material for this wavelength range. Modeling of laser performance with these quantized structures and improvements in device processing and packaging techniques will lead to actual fabrication of the optimum laser design in Phase II.

FIBER & SENSOR TECHNOLOGIES, INC.
P.O. BOX 11704
BLACKSBURG, VA 24062
Phone: (703) 231-4224

Topic#: 93-015
Office: AFOSR
Contract #: FQ8671-9301354
PI: Mark S Miller

ID#: 93AFO-113

Title: Analytical Characterization of Sensor/Actuator embedded Intelligent Materials

Abstract: The objective of this research is to develop a precise analytical depiction of the micro-level stress state in an intelligent material containing sensors and actuators. This state-of-the-art theoretical construct employs classical elasticity solutions, methodologies associated with finite element analysis, and local stress averaging techniques to develop a precise solution to the non-linear problem presented by such a material. This will be the first of its kind for an intelligent material system. The analytical model will be experimentally verified with the latest in technological developments for determining the micro-stress fields that exist around embedded inclusions. Experimental verification of this complex analytical problem is a necessity to validate the physical assumptions employed in its development. Therefore, this research represents a significant advancement in the study of intelligent material systems through the development of a direct physical understanding that these embedded devices have on design level properties.

FIBER & SENSOR TECHNOLOGIES, INC.
P.O. BOX 11704
BLACKSBURG, VA 24062
Phone: (703) 231-8404

Topic#: 93-188
Office: WL9
Contract #: F33657-93-C-2232
PI: Tuan Tran

ID#: 93WL9-038

Title: Surface Mounted Optical Fiber Sensors for Measurement of Hypersonic Boundary Layer Instability Modes

Abstract: The high cost of development testing and pressure to reduce program time scales in the development of aircraft structures has led to increased use of advanced instrumentation. Of growing interest has been the integration of sensors into airfoil components, both to look outward at the behavior of the flow, and to look inward at the temperature and strain in the component itself. Surface-mounted sensors may allow measurement of the growth, spatial distribution and frequency content of instability waves in hypersonic boundary layers. Such measurements are required in the short term to aid in airfoil design and testing, and in the long term as part of active control surface instrumentation. Fiber and Sensor Technologies (F&S) proposes to investigate the feasibility of novel types of surface-mounted optical fiber sensors, based in part on fiber strain gauge concepts commercialized by F&S, have been demonstrated by F&S and their subcontractor, the Fiber & Electro-Optics Research Center at Virginia Tech, for detection of stress wave displacement fields on and in metals, ceramics and composites. This related prior work has been performed for numerous government laboratories, airframe manufacturers and engine manufacturers.

FLUIDYNE ENGINEERING CORP.
5900 OLSON MEMORIAL HIGHWAY
MINNEAPOLIS, MN 55422
Phone: (612) 544-2721

Topic#: 93-004
Office: AEDC
Contract #: F40600-93-C-0007
PI: Steven D. Hickel

ID#: 93AED-043

Title: Storage Heater Material Optimization

Abstract: High temperature storage heaters are needed to provide clean, hot air for aerodynamic and propulsion testing of hypersonic vehicles. Vitiation heaters do not properly simulate the vehicle flight conditions, thus limiting the ability to develop tomorrow's aircraft in a timely manner. Yttria-zirconia storage heater development work was sponsored by the Air Force in the 1960's, but did not produce an economically viable material because important details of the phase behavior of the material's crystalline structure was not known at that time. The proposed SBIR effort will use the results of recent research on yttria-stabilized zirconia to identify improved yttria-zirconia material compositions, define suitable storage heater operating conditions, and evaluate life cycle costs to establish a sound basis for development of optimum heater materials. The work will be carried out by FluiDyne with consulting assistance from St.-Gobain Norton Industrial Ceramics Corporation. FluiDyne and

60

Norton are world authorities on the application of ceramic materials to high temperature storage heaters.

FORWARD VISION
2439 BLUE QUAIL ST.
SAN ANTONIO, TX 78732
Phone: (210) 491-0089
Topic#: 93-023 ID#: 93AL -033
Office: AL
Contract #: F41624-93-C-9007
PI: Dr. Paul G. Rudolf
Title: Real Imaging Via a Virtual Reality Lens System
Abstract: A lens system even if very complicated, when computer simulated (i.e., in a "virtual reality") will function, under appropriate circumstances, as if it were real. This system requires coherent illumination of the target, so a laser or microwave source is needed, but a microchip would do the focusing. The reflected wave from the target is used as input and a picture of the reflecting object is produced. Output would be anything accepting an electronic signal (broadcast, video monitor, etc.). It will work with any radiation for which a source and detector can be built: microwaves, visible light, sonar, etc. The "virtual" lens systems can be as exotic and perfect as mathematical description will allow. It is always aligned and can have elements overlapping in space or made of materials which do not exist in nature. As long as elements and materials can be described mathematically, they can be used. The detector does no focusing itself and therefore should be resistant to input overload. Other systems now in use (like radar) do not image except at a crude level. Only reflectivity and size are measured, and then ambiguously. Very large objects, like weather systems, can be displayed, but in detail no smaller than a beams width. The Phase I project will be a computer simulation to establish feasibility. Particular emphasis will be placed on examination of optical element design and system configurations.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 93-007 ID#: 93AFC-001
Office: AFCESA
Contract #: FO8635-93-C-0089
PI: DR HARRIS GOLD
Title: Joint Electroosmotic Purging of DNAPLS From Saturated Soils
Abstract: The process of "pumping" water by electroosmosis has been used for dewatering and stabilizing soils since the 1930s, and has more recently been evaluated for treating groundwater contaminated with dissolved organics and toxic metals. Electroosmosis is particularly effective in fine pores where hydraulic pumping fails, particularly as its flow can be accurately directed. A modified process is proposed in which water is used to purge dense, non-aqueous phase (organic) liquids (DNAPLs) which are not normally susceptible to electroosmotic forces. An important advantage of this approach is that the purge liquid can be used to introduce surfactants that will enhance the rate of desorption and so remove absorbed DNAPLs that would otherwise continue to be a long-term source aquifer contamination. This in situ approach is expected to have energy costs of the order of $1/ton of soil treated and so offers significant cost savings over conventional extraction processes. The concept is to be demonstrated in a 10'3" test cell after determining operating parameters in a series of small-scale tests. In addition to the experimental investigation, the utility of a simplified theoretical model for design calculations and for predicting performance will be explored.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 93-011 ID#: 93AFC-074
Office: AFCESA
Contract #: FO8635-93-C-0105
PI: HARRIS GOLD
Title: Treatment of Soils Contaminated by Either Mercury or Depleted Uranium by Supercritical Fluid Extraction
Abstract: Some Department of Defense facilities have soils contaminated by mercury and depleted uranium. The proposed program addresses the removal of these metals by supercritical carbon dioxide fluid extraction using an innovative technique that solubilizes the metals in the carbon dioxide solvent. Supercritical extraction has several advantages over conventional processes including benign solvents, enhanced mass transfer, and the inherent capability of separating mixtures of extracted material. However, supercritical extraction is not generally applied to inorganic substances because they are relatively insoluble in non-polar solvents such as supercritical carbon dioxide. Up to now, this has excluded the possibility of treating by supercritical solvent extraction the many metal-containing hazardous waste streams generated in DoD operations. The proposed program involves (a) the synthesis of a number of CO2-soluble complexing agents specific to either mercury or depleted

(61)

uranium, (b) measurements of the solubility of the complexing agents in CO2 and the metal extraction efficiencies in soil, and (c) estimating the capital and operating cost of the super-critical solvent extraction process.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHLAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-016
Office: AFOSR
Contract #: FQ8671-9301313
PI: Dr Parviz Tayebati

ID#: 93AFO-095

Title: Novel E-O Polymers: NLO Materials with Superior Temporal Stability

Abstract: Electrooptic polymers are of major interest in areas of high frequency modulation (100 GHz) for fiber optic communication systems, laser beam scanners, and frequency doubling of lasers for high density optical data storage. For these applications, electrooptic polymers present major advantages over currently used inorganic materials including orders of magnitude higher bandwidth, higher electrooptic efficiency and ease of processing. However present electrooptic polymers are temporarily unstable, have high optical absorption, require high temperature processing and can not be oriented (poled) efficiently. In addressing these problems, Foster-Miller, Inc. proposes to synthesis two classes of new electro-optic polymers that can be processed and poled efficiently at (or below) room temperature and will retain orientation over many years. The key component of these materials are highly stable (Tg ~ 250oC to 350oC), transparent and soluble polymers recently synthesized. In Phase I, we will synthesis and evaluate the stability of our guest-host electrooptic polymers. Phase II, will further improve the temporal stability by attaching chromophores to the backbone of the proposed matrices. In collaboration with Ramar Inc., we will fabricate integrated electrooptic modulators and strategize for Phase III commercialization.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-031
Office: AL
Contract #: F41624-93-C-9012
PI: Dr Mark A Druy

ID#: 93AL -015

Title: Novel Infrared Fiber Optic Sensor for in Field ID of Hazardous Waste Solutions

Abstract: Foster-Miller, Inc. proposes to develop a novel fiber optic infrared spectro-scopic probe to allow the rapid and easy identification of organic components in hazardous waste solutions collected at Air Force sites. This unique portable instrument will make it possible for the first time for non-technical Air Force personnel to make quick, reliable in-the-field characterization of the organics in complex hazardous waste solutions stored at Air Force bases. Fourier transform infrared (FTIR) spectroscopy is the most powerful analytical technique for the identification of organic compounds but has not often been used for hazardous waste because of the lack of a suitable sampling mechanism. Foster-Miller's unique fiber optic probe with a disposable sensor coupled with our commercialization partner Bomem Inc's special field portable FTIR spectrometer and with special analytical computer software, to be developed by Foster-Miller, will accomplish this goal. The successful completion of Phase I will provide all of the necessary data to design, fabricate and test a prototype field portable device during Phase II in conjunction with Bomem and the Air Force. This will lead to commercialization of an optimized system during Phase II by the Foster-Miller-Bomem team.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-052
Office: ES3
Contract #: F30602-93-C-0137
PI: Dr. Lawrence H. Domash

ID#: 93ES3-109

Title: Reconfigurable Holographic Filters

Abstract: The development of an all solid-state, rapidly tunable optical filter will offer important advantages for many applications, including optical surveillance sensors, optical communications, optical computing and related areas. The replacement of larger, bulk-optic mechanical systems will result in lower throughput losses, lower weight and volume, and higher reliability. For this program, Foster-Miller proposes to exploit the unique properties of a new holographic film that can be reliably and repeatedly tuned with an applied voltage at millisecond speeds. The technique involves the combination of liquid crystals in a polymer holographic host. Using this composite number of optical interconnect components, active solar filters, and other optical and fiber optic devices have been previously tested. The goal of the Phase I effort will be to demonstrate wide band tuning over at least three wavelength regions with diffraction efficiencies approaching 99 percent and near zero optical

throughput losses. Multiple holographic film elements will be scanned at rates exceeding 100 Hz. In Phase II we will demonstrate a prototype multiple filter unit to be tested under realistic conditions. Commercialization issues will be explored with our partner Polaroid Corporation.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-053 ID#: 93ES3-121
Office: ES3
Contract #: F30602-93-C-0148
PI: Dr. Lawrence H. Domash

Title: Vibration-insensitive Reconfigurable Optical Interconnects

Abstract: The development of very high bandwidth reconfigurable optical interconnects is one of the important goals of present optics research. Direct broadcast interconnect schemes offer the advantage of high data rate free-space optical signals and an inherent immunity to vibration. However, in the past this technique has suffered from poor signal to noise ratio and an inability to reconfigure the network interconnections. Foster-Miller proposes to overcome these prior disadvantages by developing an electrically controlled wavelength-tunable filter which allows each detector to receive one signal with high selectivity and to reconfigure the network by changing receiving wavelengths. This device enables a broadcast interconnect scheme which is simple, low cost, reconfigurable, extendable and immune to mechanical or vibration problems. For this program we will exploit the unique properties of a new holographic film that can be reliably and repeatedly tuned with an applied voltage at millisecond speeds. The technique involves the combination of liquid crystals in a polymer holographic host. The goal of the Phase I effort will be to demonstrate selective wavelength tuning over a 5 to 10 percent bandwidth with diffraction efficiencies approaching 99 percent. The potential reconfiguration speed of the network ranges between milliseconds and microseconds, while the bandwidth of the data transfer may be in the 100 GB/s range. Commercialization issues will be explored with our partner Polaroid Corporation.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-062 ID#: 93PL1-144
Office: PL1
Contract #: F29601-93-C-0081
PI: DR. K. JAYARAJ

Title: Low Cost, Radiation Hard, Area I/O Electronic Package

Abstract: Foster-Miller proposes to develop a low cost, thermally efficient, high input/output advanced electronic package using our innovative liquid crystal polymer technology. Liquid crystal polymer with low moisture permeability provides a hermetic seal in the interconnect. Laser drilled blind vias allow routing in the multilayer built with the LCP to achieve a high density of pads per square inch in the package array. Our innovative design includes a metal matrix cover sealed onto the substrate to provide efficient thermal management. This approach can handle high I/O (800 or more) wafer scale packaging as well as three dimensional stacks of MCMs. No other polymer-based approach can provide a hermetic package. Ceramic-based approaches are too expensive or cannot be implemented in such a space efficient manner. The multilayer substrate approach based on LCP also offers superior electrical properties. The substrate layers could be readily increased to provide features such as power distribution planes to control the characteristic impedance which will enable higher bandwidth applications. The material Foster-Miller uses can be fabricated with photo-lithography techniques used in thin film and is readily scalable to much higher I/O pin counts than conventional approaches. In Phase I, teaming with a Micro-Pak, laser drilling of LCP and hermetic sealing will be demonstrated by building several prototypes which will also show the thermal management technology and the circuit routing that provides the high density. In Phase II functional prototypes of 1600 and higher I/O will be built, assembled with functional ILS and fully tested. A thorough electrical, thermal and mechanical reliability characterization will be performed. This prototype will be based on an actual product being developed by our system designer team member.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-068 ID#: 93PL1-173
Office: PL1
Contract #: F29601-93-C-0092
PI: GLENN FREITAS

Title: Out-of-furnace Brazing Technology for Assembly of Large Carbon-Carbon Space Structures

Abstract: Foster-Miller has previously developed an attachment scheme for 2-D carbon-carbon (C/C) composites which,

compared to a conventional braze or mechanical joint, would enhance the thermal and mechanical efficiency of space structures. Developed for NASP applications, the design is comprised of a metal brazed joint that is integrally reinforced by transverse (Z-direction) pins. Preliminary results reveal a threefold increase in joining strength and up to 50% increase in through-thickness thermal conductivity. Unfortunately, as in the case for most C/C brazing research being conducted in the US, Foster-Miller's process has been developed for a vacuum furnace. Real military space structures, such as the Space Based Radar or Survivable Power Subsystem, involve complex truss structures that may exceed 350 ft in length. The space structure manufacturing community would certainly benefit from the development of an out-of-furnace on-line joining for sequential assembly of large structures. Foster-Miller proposes to demonstrate that RF induction heating is the key to implementing the Z-direction reinforced brazed joint on the shop floor. Induction heating is rapid, highly localized and involves inexpensive, easy-to-use equipment. By using high strength electrically conductive fibers as reinforcement, the Z-fibers will not only provide performance advantages, but may overcome some of the heating uniformity problems associated with RF heating of anisotropic composites. Based on materials and applications input from Rockwell-Space Systems and Lockheed Missile and Space Company and induction equipment expertise from Ameritherm Inc., the Phase I program will focus on understanding the interaction of the C/C adherents, Z-direction fibers, and braze with the induction coil and machine parameters. Brazed joints will be subjected to mechanical and thermal conductivity tests. Phase II would involve process optimization and development of a prototype fabrication line.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-118
Office: WL3
Contract #: F33615-93-C-1237
PI: Dr K. Jayaraj

ID#: 93WL3-019

Title: Integrated Packages Using Innovative High Temperature Packaging/Interconnect with Metal/Ceramic Bonding

Abstract: Foster-Miller proposes to develop processes for GaAs semiconductor interconnection on diamond and silicon carbide substrates for (MMIC) modules. Foster-Miller also proposes to develop high temperature bonding processes for bonding copper heat-sinks to diamond and silicon carbide substrates for (MMIC) devices, based on forming thin film adhesion layers with innovative metallurgical chemistries. In Phase I, Foster-Miller will conduct process development feasibility studies and will characterize new heatsink bonding, heatsink materials, and chip to chip interconnection materials using diamond, silicon carbide, and copper. An analysis will be performed on critical applications that require high temperature bonding processes to solve CTE and material adhesion issues. In Phase II, Foster-Miller will develop those processes found to be feasible, and in conjunction with several vendors such as Alliant Tech Systems, Honeywell and General Dynamics, fabricate specific MMIC modules. Foster-Miller will team with a specific customer to further develop this technology, with the goal of commercializing this technology in Phase III. This development will result in an innovative approach to production of MMIC modules for Phased Array systems that will be of high performance and cost effective.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-124
Office: WL4
Contract #: F33615-93-C-3205
PI: Dr John J. Gassner

ID#: 93WL4-021

Title: Innovative Low Cost, Lightweight Sandwich Cores

Abstract: The availability of lightweight, low cost core materials for sandwich construction could dramatically improve Air Force composite structures across-the-board. In this program, Foster-Miller will demonstrate the huge advances that are possible by applying advanced materials technology, including blends of high performance polymers such as LaRC-TPI 1500/Xydar, to the production of new forms of foam and honeycomb core materials for aircraft applications. The use of these advanced polymeric materials in cores would make available thermally stable, melt-processible sandwich structures which are strong and stiff, lightweight, insensitive to moisture, and dimensionally-stable. Using our extensive processing experience with advanced polymers and their blends, and making use of the expertise of teaming partners Hexcel and Vought, Foster-Miller will examine the feasibility and practicality of honeycomb cores made from these materials. Furthermore, we will examine the ability to fabricate foam core materials which have 2 to 3 times the specific stiffness of the best aerospace foam material currently available. The work plan provides a balanced and coordinated approach including analysis, processing experiments, production of actual core material, and determination of core material properties. Also included is an economic analysis of the potential cost of the advanced core material in production.

64

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-124 ID#: 93WL4-031
Office: WL4
Contract #: F33615-93-C-3207
PI: Glenn A. Freitad

Title: Manufacturing Technology for Continuous Intersection Frame and Stringer Preforms for Advanced Fuselage Structure

Abstract: The composites industry has spent several years developing material systems for aircraft structure. Confidence has been built applying composites to such aircraft as the A6, V22, B2, and F22 Prototype. Now that composite materials have been proven the focus is shifted to obvious limitations in manufacturing technology. Significant weight reductions, cost savings, and performance enhancements can still be made by the development of advanced manufacturing technologies. A limiting factor for composites has been the issue of attachment. Most attachment schemes center about what is acceptable for metals. Taking advantage of the flexibility of composites can eliminate much of the demanding fastening requirements. Composite structure such as intersecting ribs and spars or frames and stringers is an excellent example. Current composite fuselage concepts have a stringer mouse-hole cut in a frame and/or use a combination of clips, doublers, rivets and bolts to assure attachment. This is a costly process that adds weight and increases manufacturing risk. Foster-Miller is proposing advanced braided performing technology which will produce a continuous intersecting structure. In the case of a composite fuselage a continuous frame would be fabricated with continuous intersection spars. Fibers which make up the spar would be continuous through the frame eliminating the need for attachment at this critical location. In Phase I demonstration intersecting or cruciform structure will be fabricated. Several demonstration articles will be impregnated cured and tested to determine structural integrity. In addition enhanced quality functional deployment (EQFD), which integrates House of Quality methodology and Pugh concept analysis techniques will be employed to determine critical components for process automation. One determined component will be conceptualized, designed, fabricated and demonstrated.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-135 ID#: 93WL5-074
Office: WL5
Contract #: F33615-93-C-5353
PI: Thomas G Campbell

Title: High Thermal-thickness Thermal Conductivity for Thermal Management in Advanced Composite Material

Abstract: There is a need to minimize the optical signature of Air Force aircraft. The infrared region of the electromagnetic spectrum is of special concern. Foster-Miller proposes to develop a through-the thickness high thermal conductivity composite laminate using our proprietary z-fiber technology. This effort will be aided by our subcontractor, Rockwell North American Aircraft (NAA). They will provide their significant expertise in aircraft thermal management. The Phase II program will focus on an actual aircraft component as defined by the Air Force and Rockwell. Thermal conductivity improvements of 15 times through-the-thickness are anticipated relative to standard carbon epoxy laminates.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 93-138 ID#: 93WL5-161
Office: WL5
Contract #: F33615-93-C-5330
PI: Ted E Kirchner

Title: Effective NDE of Composites Through High Resolution Areal Tomosynthesis

Abstract: Modern composites are complex, anisotropic and have a propensity to hide flaws and impact damage. Because current NDE techniques are inadequate, the full benefits of composites are unrealized as all these uncertainties demand greater safety factors that result in structures two to four times as massive as they would otherwise be. X-ray laminography is a superior NDE technique for composites with its layer by layer laminographic reconstruction through a composite thickness. But as currently practiced, laminography is extremely slow, cumbersome and requires the use of expensive/large special purpose linear detector arrays and precise/expensive test specimen registration equipment. Our innovation accomplishes X-ray laminography using a high resolution areal X-ray camera developed by the Air Force/Lockheed, the technique eliminates the need for expensive mechanical registration equipment, is not limited to planar surfaces and most important, it is an order of magnitude faster than conventional X-ray laminography. In our proposed Phase I program, Lockheed will permit us to obtain data on a flawed composite using their new areal camera to demonstrate the superior performance of our High Resolution Areal Tomosynthesis (HAT) System. In Phase II we will design, build and demonstrate a prototype HAT that would incorporate the AF/Lockheed camera.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 93-139 ID#: 93WL5-209
Office: WL5
Contract #: F33615-93-C-5345
PI: Dr Robert F Kovar
Title: Bacteriorhodopsin Spatial Light Modulator

Abstract: Spatial light modulators (SLM's) are critical components of optical devices but currently show slow response times, low sensitivity, poor resolution and short lifetimes. Bacteriorhodopsin (BR) is the best candidate for SLM's because it exhibits picosecond response, high quantum yield, sensitivity to low light intensities, photochemical stability and broad wavelength response. Highly-oriented BR films of optical quality are needed, but not available. Foster-Miller will team with a biotech company to purify BR by removing carotenoids, ionic species and other impurities. Then we will combine sol-gel processing with our successful BR film electric field orientation process to produce optically clear, BR/sol-gel (BR/SiO2) nanocomposite films that contain highly-oriented BR molecules locked-in-placed within a matrix or rigid glass. BR/SiO2 films will be more transparent than BR films and will show better SLM response due to their higher BR purity, orientation and concentration. Our team includes renowned BR experts and Foster-Miller laser physicists who have already electro-deposited oriented BR films. In Phase I, we will prepare oriented BR/SiO2 films of high optical quality, demonstrate improved sensitivity and resolution and begin design of the BR-SLM device. In Phase II, we will fabricate a compatible, working BR-SLM for system testing.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 93-143 ID#: 93WL5-309
Office: WL5
Contract #: F33615-93-C-5350
PI: Dr Robert F Kovar
Title: Biodegradable Plastic Media Blast Materials

Abstract: We propose to develop a new class of Biodegradable PMB (BPMB) material that will efficiently remove paint from metal and composite surfaces of aircraft structures and components. The aggressiveness of this new blast medium is capable of being tailored to meet the requirements of specific applications. In addition, the successful PMB material will not damage substrate surfaces, will have a long product life, will be biodegradable, and available in large quantities at competitive costs. Foster-Miller has assembled a strong industrial team to ensure that this technology receives superior technical support during Phase I, can be reduced to practice in a Phase II program, and can provide BPMB distribution and equipment manufacturing for both the military and commercial sectors. During Phase I, Foster-Miller will demonstrate the feasibility of our approach. We will review four development options: BPMBs made from an all-biodegradable polymer, copolymerization of biodegradable polymers, physical blends of two or more biodegradable polymers, and biodegradable polymers filled with inclusions of various hardnesses. We will select the most promising option and materials to compound and mold into test coupons and grind into blast media. The coupons will be tested for mechanical properties including toughness and hardness. The blast media will be analyzed for biodegradability and stripping efficiency. The outcome of these tests will be used to establish the economics of the BPMB system.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 93-144 ID#: 93WL5-318
Office: WL5
Contract #: F33615-93-C-5349
PI: Dr William E Dorogy Jr
Title: Functionally-radient Sol-gel Coatings for Aircraft Aluminum Alloys

Abstract: Foster-Miller, Inc.'s approach is to generate functionally gradient sol-gel coatings in a single step process to replace the standard and water intensive process of chemical or electrolytic pretreatment (generating an alumina layer) followed by primer (containing corrosion inhibitors) application. These coatings would chemically bond to the native oxide on aluminum to form a corrosion protection barrier that gradually transitions into a region with suitable functionality for chemically interacting with the adhesive. Fundamental research on functionally gradient sol-gel coatings derived from tetraethoxysilane/aminoalkyltriethoxysilane mixtures has produced lap-shear joints exhibiting significantly improved environmental resistance. However, these coatings are subject to abrasive damage, resulting in substrate corrosion. Altering the composition of this functionalized region and electrophoretic processing (if required) to increase the coating hardness and density would allow more damage tolerant coatings to be formulated. Incorporating modified-transition metal alkoxides (whose oxides are harder than silica) and modified-alkoxysilanes (for adhesive bonding) will improve the hardness and adhesion

66

characteristics of the coating. In Phase I, Foster-Miller will team with Lord Corporation and Lockheed to evaluate and select materials and approaches to generate functionally gradient sol-gel coatings on aluminum alloys that provide corrosion protection and good adhesive surfaces. Phase II involves the optimization of the coating characteristics and process parameters.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 93-183 ID#: 93WL0-254
Office: WL0
Contract #: F08630-93-C-0051
PI: Or. Mark A. Druy
Title: Ferromagnetic Polymers for Inductively Coupled Fuzes
Abstract: Inductive couplers are foreseen as an implement to modular design of advanced fuzes. Ferrite pot cores have been used for increased coupling efficiency, but are undesirable for use in hard target penetrator weapons due to their brittleness. Recently, magnetic ordering phenomena have been observed in a number of organic systems. These ferromagnetic polymers would seem to be an ideal choice as a binder for ferrite powders; however, these materials have yet to reach their full potential as magnetic systems due to the fact that the science of synthesis and post-processing of these materials is still in its infancy. Most of the ferromagnetic polymers discovered thus far exhibit magnetic interactions along the polymer backbone only; however, three-dimensional order is necessary to obtain the bulk magnetic properties desired. The Foster-Miller approach will develop novel orientation techniques which will result in permanent three-dimensional alignment of magnetic domains in ferromagnetic polymers. By controlling the morphology and chemistry of the most advanced ferromagnetic polymers, Foster-Miller will achieve an order of magnitude improvement in magnetic properties. In Phase I, Foster-Miller will work with California Institute of Technology (Prof. Dougherty - inventor of organic ferromagnets), and DuPont (Joel Miller - inventor of room temperature organometallic magnetic materials) to impart morphology control to most advanced ferromagnetic polymers to achieve 10X improvement in magnetic properties. In Phase II, we will team with KDI (a fuze manufacturer) to demonstrate a mechanically robust fuze with excellent magnetic properties.

FRONTIER TECHNOLOGY, INC.
530 E. MONTECITO, SUITE 105
SANTA BARBARA, CA 93103
Phone: (805) 965-2477
Topic#: 93-115 ID#: 93WL2-087
Office: WL2
Contract #: F33615-93-C-1250
PI: Joseph Leo Nolan
Title: Active Expendable Electronic Counter Countermeasure (ECCM)
Abstract: The proposed Phase I research program will define and evaluate techniques and tactics intended to counter active expendable electronic countermeasures (ECM) threats to air-launched radar-guided weapon systems. Performance will be measured in terms of the missile seeker's ability to discriminate between the expendable and the true target. These performance evaluations, together with qualitative assessments of operational complexity, robustness and any adverse impacts on cost and system utility, will provide a basis for recommending one or more of the techniques for further development and evaluation in Phase II of the program. The Phase I program also will specify the technology requirements, design data requirements and development requirements, for the selected techniques and recommend a Phase II program plan designed to achieve these goals.

FRONTIER TECHNOLOGY, INC.
4141 COL GLENN HWY, SUITE 140
BEAVERCREEK, OH 45431
Phone: (513) 429-3302
Topic#: 93-159 ID#: 93XRX-154
Office: XRX
Contract #: F33657-93-C-2285
PI: John Denelsbeck
Title: Evaluation Methodology for Hypersonic Applications
Abstract: To develop an evaluation aid for Hypersonic Technologies, it will be necessary in this effort to achieve three technical objectives. First, a traceability from our national security objectives to the specific regional military objectives and tasks under Defense Planning Guidance Scenarios. This traceability must follow a consistent set of ground rules such as the functional capability requirements for each mission area are defined and their current mission models that have been developed are matched to the specific requirements at hand. The second objective is to establish a modeling methodology that will account for all the unique features that hypersonic systems present. This methodology must establish measures of effectiveness and measures of merit based upon the specific technological capabilities and cost uncertainties associated with future hypersonic technologies. Third, we must be able to prioritize various technological solutions offered by hypersonics. To meeting the specific military

objectives and tasks defined during the baseline analysis.

FTC ACQUISITION CORP.
2539-C NOBLIN ROAD, P.O. BOX 40968
RALEIGH, NC 27629
Phone: (919) 850-0600
Topic#: 93-011
Office: AFCESA
Contract #: FO8635-93-C-0108
PI: JAMES A. HEIST
ID#: 93AFC-102

Title: Material Recycling and Waste Minimization by Freeze Crystal Corporation

Abstract: In Phase I this program will demonstrate the applicability of the freeze crystallization (FC) process directly to U.S. Air Force environmental managers by (1) finding applications that are well served by this technology, (2) demonstrating the capabilities of the FC process by processing wastes in FTCAC's lab pilot plant facilities, and (3) developing a design for a prototype FC plant that will be built under Phase II and placed in the field for demonstration testing on actual waste streams. It is shown in this proposal that FC is a process with wide-ranging capability for recycling materials that are now disposed of as waste and for meeting the increasingly stringent limits on air and water discharges from industrial facilities. This process is generally applicable to both aqueous and organic-based solutions and will provide high quality purity treated water for discharge, regardless of the type of contaminant that is in it. Potential applications for this technology include: recycling paint stripping solvents that are now incinerated (e.g., dichlorobenzene and normal-methyl pryollidone); more complete removal of VOCs, semi-volatile compounds, heavy organics, heavy metals and radionuclides from contaminated effluents and groundwater; decontamination of aviation fuels; recycling of all effluents from metal finishing operations; decontamination and rejuvenation of acid and alkaline cleaning bathes.

FTC ACQUISITION CORP.
2539-C NOBLIN ROAD, P.O. BOX 40968
RALEIGH, NC 27629
Phone: (919) 850-0600
Topic#: 93-095
Office: PL3
Contract #: F04611-93-C-0092
PI: James A. Heist
ID#: 93PL3-049

Title: Oxidizer Scrubber Solution Recycling by Freeze Crystallization

Abstract: When loading nitrogen tetroxide before launching the space shuttle, fugitive N2O4 is absorbed into caustic solutions in a two stage scrubber solution. The second stage of the scrubber has sodium sulfite added to the alkaline scrubbing solution to act as an oxidant scavenger, to improve scrubbing efficiency. The N2O4 oxidant reacts with water and with the sulfite to form acids (neutralized by the alkalinity in the solution) and sulfates. The residual caustic concentration makes the spent solution a characteristic hazardous waste. This proposal addresses an approach that uses freeze crystallization to crystallize sodium nitrate and sodium sulfate salts from the spent scrubbing solution, to remove part of the water in the spent solution as pure ice, and thus to concentrate and purify the residual hydroxide alkalinity so that it can be reused in the scrubbing operation. To improve the efficiency in removing the nitrate and sulfate salts, nitrites and sulfites will be oxidized by adding air. Testing here will determine whether this needs to be a pressurized reaction, or if atmospheric conditions are sufficient. The hydroxide can be crystallized from the treating solution if necessary to recover it at higher concentrations or in ultra-high purity.

G.A.TYLER ASSOC., INC.
P.O. BOX 25039
ANAHEIM, CA 92825
Phone: (714) 772-7668
Topic#: 93-083
Office: PL1
Contract #: F29601-93-C-0069
PI: DR. GLENN A. TYLER
ID#: 93PL1-930

Title: Data Processing Routines for Adaptive Optics Systems

Abstract: A program is proposed to develop data processing routines for adaptive optics. These routines will be such that they run on a PC, such as a 486, and are compatible with commercial software packages, such as MATLAB, Matrix X, or Control C. A key feature of this work is the breadth of experience that the Optical Sciences Company has in both adaptive optics testing/analysis and software development. To demonstrate this fact, some data processing routines for adaptive optics have been coded into MATLAB and used to process real data. These results are presented in this proposal and serve to illustrate that the Optical Sciences Company is very far along in this area of activity, thereby ensuring that the government will obtain the best return on its investment if the Optical Sciences Company is selected.

GALAXY SCIENTIFIC CORP.
HARBOR CREEK OFFICE PK, BLDG11, 2500 ENGLISH CREEK
PLEASANTVILLE, NJ 08232
Phone: (404) 491-1100
Topic#: 93-029 ID#: 93AL-056
Office: AL
Contract #: F41624-93-C-5005
PI: William B Johnson, PhD
Title: The Use of Gaming for Intelligent Technical Training
Abstract: The objective of this Phase I proposal is to show that a gaming approach to training is more effective than a non-gaming approach to training. The proposed system will incorporate previously developed Intelligent Tutoring System software (MITT and MITT Writer) with newly developed software to produce a training environment that utilizes gaming techniques. Following this development there will be a pilot study comparing both the gaming and non-gaming systems. The benefits of a gaming environment are that they provide a stimulating and motivational approach to technical training.

GENERAL PNEUMATICS CORP.
7662 E. GRAY ROAD, SUITE 107
SCOTTSDALE, AZ 85260
Phone: (602) 998-1856
Topic#: 93-065 ID#: 93PL1-029
Office: PL1
Contract #: F29601-93-C-0085
PI: MR. WOODY ELLISON
Title: Advanced Regenerators for Very Low Temperature Cryocoolers
Abstract: Proposed is a new concept for high effectiveness regenerative heat exchangers which are critically needed to develop efficient cryocoolers for operation at temperatures of 10K and below. Development of light weight, power efficient, long life cryocoolers capable of providing refrigeration at and below 10K has become a critically-pacing technology for spaceborne instrumentation. The best current 10K cryocoolers are impractically large, inefficient, and unreliable for aerospace applications. This is largely due to fundamental problems with regenerator ineffectiveness at very low temperature. The new type of regenerators proposed offers for 10K cryocoolers the reductions of 100s of watts of power and kilograms of weight per watt of refrigeration, and extension of operating life by 10,000's of hours. The proposed research will define the analytical modeling, thermofluid performance trade-offs, material properties, production and test methods for such high effectiveness regenerators.

GENERAL SCIENCES, INC.
205 SCHOOLHOUSE ROAD
SOUDERTON, PA 18964
Phone: (215) 723-8588
Topic#: 93-105 ID#: 93PL6-009
Office: PL6
Contract #: F04704-93-C-0009
PI: Paul Juneau
Title: Material Concepts for Electromagnetic Transmission Through Plasma
Abstract: This program will investigate the feasibility of developing plasma reducing material concepts to facilitate electromagnetic transmission through plasma layer of a hypersonic maneuvering vehicle. Various plasma reducing material concepts will be identified and compared, and the more promising concepts will be selected for further evaluation and development. Material concepts to be considered will include electrophilic and ion trapping heat shield additives and coatings, low temperature passive ablators with quenchant additives, and active coolant/quenchants. Test specimens will be prepared and tested in the GSI Microwave/IR Flame Apparatus to determine the effectiveness of candidate test materials in reducing seeded flame electron densities and microwave and IR radiation. An assessment will be made of the relative effect of materials on signal attenuation for a simplified hypersonic maneuvering vehicle at flight conditions by use of analytic non-equilibrium flow field and electromagnetic prediction techniques.

GMF, INC.
6104 QUEENS BRIGADE COURT
FAIRFAX, VA 22030
Phone: (703) 830-2050
Topic#: 93-110 ID#: 93WL2-007
Office: WL2
Contract #: F33615-93-C-1248
PI: Dr. John Green
Title: Sorting of Networked Communications Signals
Abstract: A need exists to de-interleave different emitters active in multiple access communications environments. Tracking of emissions from a given user is a significant problem. A major difficulty is presented by the fact that the gross signal characteristics of all users are generally equivalent, since each user must satisfy joint communication system signal and protocol requirements. GMF proposes to adapt radar-based sorting algorithms for application to networked communications signal sorting. GMF is presently providing advanced technology in radar signal sorting to the Air Force, and has been recognized by

the Air Force as a major contributor and innovator in this area. Radar-based signal sorting techniques of potential interest for this application include those which utilize intrinsic emitter parameters (e.g., PRI), extrinsic emitter parameters (e.g., geometric), and emitter signal intrapulse characteristics. GMF will make use, in this proposed effort, of its prior experience in applications of sorting technology to communications signals.

GPS SOLUTIONS
P.O. BOX 355
BOULDER, CO 80306
Phone: (303) 444-2065

Topic#: 93-098 ID#: 93PLA-031
Office: PLA
Contract #: F19628-93-C-0064
PI: Dr Christian Rocken

Title: Multipath Correction for Global Positioning System Satellite Range Measurements

Abstract: Two methods are proposed to reduce GPS range and carrier phase multipath. Both methods are based on the assumption that multipath can be described as a function of elevation and azimuth. The proposed methods determined site-specific "multipath correction maps". The first method forms linear combinations of the four GPS observation types to compute range multipath as a function of elevation and azimuth. The advantage of this method is its simplicity and its potential for automatically updating the "multipath correction maps". However, the method is based on approximations that must be verified as part of the proposed research. For the second method we will design a "zero-multipath" antenna setup. This "zero-multipath" antenna, operated on a high, portable tower shall be used in differential mode to monitor multipath at a selected site. This second technique can determine site-specific corrections in real-time or post-processing GPS processing packages. During Phase I we will develop hardware, software, and experimentally test the feasibility of both multipath reduction approaches.

H.V. SETTY ENTERPRISES, INC.
12110 RED OAK COURT SO
BURNSVILLE, MN 55337
Phone: (612) 894-2792

Topic#: 93-011 ID#: 93AFC-118
Office: AFCESA
Contract #: FO8635-93-C-0095
PI: H.V. VENKATASETTY

Title: Environmental Engineering Research

Abstract: The development of a low-cost reliable and long-life novel, electrochemical sensor with multigas sensing capability that can detect 10 ppb of toxic gases and vapors with a response time of 30 seconds is proposed. During Phase I, we will develop an electrochemical amperometric sensor cell with a three electrode configuration using nonaqueous aprotic electrolyte solution. This nonaqueous electrolyte solution will assure shelf life, long operating life, and high selectivity. This sensor cell with conventional potentiostat and voltage scanning technique will be used to test for its performance in terms of sensitivity, selectivity, repeatability, and response time. Appropriate chemicals will be used as stimulants for toxic gases. The sensor will be tested for its multigas sensing capability to detect and monitor toxic gases like hydrazine and its derivatives and organic vapors such as chloroethylene and carbon tetrachloride in low concentrations. These sensors are useful to the Air Force at Rocket Installations, Missile Sites, and Hazardous Waste Sites.

HARRIS MILLER & HANSON, INC.
429 MARRETT ROAD
LEXINGTON, MA 02173
Phone: (617) 863-1401

Topic#: 93-033 ID#: 93AL -155
Office: AL
Contract #: F41624-93-C-9011
PI: Richard D. Horonjeff

Title: Proposal to Assess the Feasibility of Automated Collection and Display of Aircraft Information for Environmental Noise Analyses

Abstract: Noise has consistently been the highest visibility environmental issue facing civil and military air facilities in the United States and abroad. Over the past two decades, models and databases of increasing computational accuracy and sophistication have been developed for depicting environmental impact. In many situations however, input data reliability, not model sophistication, has been the limiting factor in the overall accuracy and defensibility of the end product. This study investigates the feasibility of automatically accessing digitally encoded data from the Air Force's air traffic control Programmable Indicator Data Processor (PIDP) and using this data to develop input to the DoD NOISEMAP/BASEOPS computer programs. Objectives of the project are (1) to assess and document hardware options for extracting data from the PIDP system and to determine the preliminary requirements for an automated, on-site data extraction and storage system, (2) to assess the feasibility of developing a sufficiently sized database to accurately determine annual average values of data parameters (such as flight corridors, altitude

and speed profiles, numbers of operations, runway and corridor use), and (3) to assess the feasibility of developing a computer-based, interactive system for generating NOISEMAP/BASEOPS input parameters directly from this database in a consistent and repeatable fashion.

HOLLIDAY LABS
19524 YOUNG ROAD
GUYSVILLE, OH 45735
Phone: (614) 662-2504

Topic#: 93-065 ID#: 93PL1-231
Office: PL1
Contract #: F29601-93-C-0086
PI: JEFFREY C. HOLLIDAY

Title: Innovative Linear Reciprocating Motor Technology for Advanced Cryocooler Systems

Abstract: This proposal is for the development of innovative linearly motor technology for application to a range of cryocooler systems of interest to DoD, including Stirling cycle, pulse-tube, and Joule-Thomson coolers. The VULCAN linear motor concept principle has been proven in hardware applications involving Stirling cycle refrigerators and electrical generators. The VULCAN linear motor offers significant advantages over the moving coil and other types commonly used in cryocoolers. Among these are: (1) higher conversion efficiency; (2) very low EMI; (3) total elimination of contaminant out-gassing materials from the working fluid; (4) high specific power; (5) compact size; (6) removal of heat generating components from the working fluid; (7) elimination of flexing electrical contact and pressure vessel feed-throughs. The proposed effort will consider a range of cryocooler applications of interest to DoD, and identify a target for which the VULCAN motor concept can offer the greatest benefit over other technologies. The Phase I includes the design and performance analysis of two versions of the VULCAN motor for the targeted application, a Fundamental and Advanced Features unit. Prototypes of these two designs will then be built, tested and evaluated in Phase II.

HORINE ENGINEERS, INC.
PO BOX 2027
LOS GATOS, CA 95031
Phone: (408) 354-3759

Topic#: 93-038 ID#: 93ES2-170
Office: ES2
Contract #: F19628-93-C-0189
PI: Carlton L. Horine

Title: Electromagnetic Shielding for Composite Shelters

Abstract: The weakest link in the shielding protection for a current shelter is at the door seam. For the proposed shelter, the door seam will be shielded with a "Pressure Stabilized Gasket System" that was designed and tested by HEI under a previous Army (HDL) SBIR contract. This gasket system was tested with a contact pressure of 35 psi (corresponding to a SE of over 60 dB to H field at 150 KHz). This subscale test demonstrated that this design could operate for over 5000 cycles of door closings and openings without any fatigue failures. Alternatively, a heavy weight gasket system will be studied using the stress relaxation data for the gasket elastomeric core that was developed in this same HDL project. Both of these door seam shielding designs will be tailored for the proposed shelter to provide a 15 year service life. Design/fabrication will be studied concurrently. In addition to the door seam shielding, design work will emphasize new and existing shielding materials, joints and corners in EM shields. Matrix and reinforcement materials will be selected. Conceptual designs using several assemblies will be prepared and assessed for efficiency.

HUGHES ASSOC., INC.
6770 OAK HALL LANE, SUITE 125
COLUMBIA, MD 21045
Phone: (301) 596-2190

Topic#: 93-009 ID#: 93AFC-031
Office: AFCESA
Contract #: FO8635-93-C-0111
PI: CHRISTOPHER P. HANAUSKA

Title: Improved Formulation of Fire Fighting Agents for Hydrocarbon Fuel Fires

Abstract: Aqueous film-forming foam (AFFF) is a superior agent for extinguishing hydrocarbon fuel fires. The very elements that contribute to its extinguishing proficiency result in undesirable environmental effects. Since the extinguishment mechanism is not well understood, the Phase I effort will focus on developing governing equations which may be used to predict foam performance on hydrocarbon liquids. This work would then be the basis for fabricating small-scale test apparatus and investigating candidate agents in Phase II. Alternative surfactant and stabilizer compounds which are environmentally benign will be identified in Phase I.

HUMPAL-PEARSON, INC.
PO BOX 343
SAN RAMON, CA 94583
Phone: (510) 735-1433

Topic#: 93-120 ID#: 93WL3-039
Office: WL3
Contract #: F33615-93-C-1253
PI: Harold Hupal

Title: Machine Thinning of Gallium Arsenide (GaAs) Wafers

Abstract: The public domain literature contains no information concerning one pass diamond turning (micromachining). It is a process that has the potential of achieving wafer thickness, and parallelisms that exceeds the quality of present day lapping and polishing practices. The principal investigator has had extensive experience in backside thinning having recently published a Final Report WRDC-TR-90-4139 entitled "Evaluating Micromachined GaAs Wafers". The information in this proposal is an extension of that earlier work and it shows that one pass thinning of GaAs has a high probability of succeeding. However, diamond turning machines (DTM) in general must be modified before they can achieve high quality thickness control and parallelism under competitive production conditions. The modifications necessary to convert and industry standard DTM (Moore Special tools m-18 AG) into a competitive backside thinning machine is conceptually provided. Phase I delivers one thinned GaAs wafer (100 micron thick) with a full physical and electronic characterization. In Phase II groups of wafers will be thinned so that the full extent of subsurface damage can be evaluated. Testing is planned to conclusively prove that one pass thinning is competitive or better than present day lapping and polishing.

HUNTINGTON RESEARCH & ENGINEERING
P.O. BOX 90118
SAN JOSE, CA 95109
Phone: (408) 293-9425

Topic#: 93-164 ID#: 93WL0-245
Office: WL0
Contract #: F08630-93-C-0025
PI: John H. Huntington

Title: Wave Gun Implementation at the Eglin AFB Aeroballistic Range Facility

Abstract: The Aeroballistic Range Facility (ARF) at Eglin Air Force Base needs to improve the operational and ballistic characteristics of launchers used in testing aerodynamic configurations in its instrumented range. A high piezometric efficiency is required to reduce acceleration loads exerted on fragile projectiles. It is also desirable to reduce or eliminate shocks in the light gas. A longer barrel also would be beneficial. The launchers are constrained to a total length of approximately 30 ft. The Wave Gun is an ideal candidate for this application in that its inherent characteristics match the ARF requirements. It provides several propulsion pulses to the projectile as it accelerates down the barrel, which significantly increases piezometric efficiency. It employs a short pump tube, allowing for a longer barrel in the confined space available at ARF. The consumables can be incorporated into cartridges, facilitating turnaround. Additional experience with single-shot Wave Gun can lead to improved understanding of its potential for weaponization. A Phase I SBIR program is proposed that will address the specific requirements of ARF, perform interior ballistic calculations with the AIBAL code which was developed and proven for Wave Gun performance analysis, and produce a design optimized for ARF. The potential utility of existing Wave Gun hardware will be evaluated as part of this effort.

HYPER-THERM, INC.
18411 GOTHARD STREET, UNITS B&C
HUNTINGTON BEACH, CA 92648
Phone: (714) 375-4085

Topic#: 93-187 ID#: 93WL9-005
Office: WL9
Contract #: F33657-93C-2241
PI: Wayne S. Steffier

Title: Development of Regeneratively Cooled C/SiC Composite Heat Exchangers

Abstract: This project aims to develop nonpermeable thin-gauge carbon tubing with an integral radial carbon fiber brush on its outer surface for enhanced heat transfer. The carbon tubing is derived from polyimide tubing. The radial fiber structure is created by electrostatic flocking. Coatings to block hydrogen permeation and to protect against erosion are applied by chemical vapor deposition. The proposed process is suited for various gauges of tubing and for various curvatures. The flocked carbon tubing may be integrated with carbon fiber preforms and processed to form an actively cooled carbon-carbon structural component for use with hot pressurized hydrogen. The Phase I effort will focus on materials processing. We will investigate the carbonization of selected precursors, fiber flocking methods, and CVD coatings. Electron microscopy will be used to inspect the tubing wall and fiber attachment. Sections of flocked carbon tubing will be fabricated for thermal cycling, and measurements of permeation and the rate of erosion in hot hydrogen. Preliminary thermal analysis will model carbon-carbon heat exchanger structures with the new tubing to investigate design trades and assess the overall performance. A draft design for a Phase II prototype heat exchanger panel will be prepared. Phase II would continue process development, leading to fabrication of a

prototype heat exchanger panel to be tested under conditions relevant to the NASP leading edge application.

HYPERSONICS, INC.
164 FERNE COURT
PALO ALTO, CA 94306
Phone: (415) 856-3013
Topic#: 93-105
Office: PL6
Contract #: F04704-93-C-0008
PI: Raul J. Conti
ID#: 93PL6-012
Title: Development of Base-flow Computer Code
Abstract: The proposed program would develop a computer code for analyzing the flow near the base and in the near-wake of reentry vehicles and wind-tunnel models to assess base effects and support-interference effects.

HYPERSONICS, INC.
164 FERNE COURT
PALO ALTO, CA 94306
Phone: (415) 856-3013
Topic#: 93-105
Office: PL6
Contract #: F04704-93-C-0007
PI: Raul J. Conti
ID#: 93PL6-041
Title: RF Performance Measurements in Simulated Reentry Environments
Abstract: The purpose of the proposed program is to develop an experimental capability to evaluate the microwave performance of advanced RF sensors in simulated reentry environments. This means specifically the measurement of RF transmission (propagation and phase), reflection, beam pattern and, if applicable, plasma flow fields with the antenna at flight temperatures. The proposed program will address C- to Ka-band antennas. Based on a detailed review of ground test aeroheating capabilities, the most promising facility is an arc-heater channel equipped with an innovative modification to be developed in the proposed program. Detailed analysis, conceptual design and integration with existing facilities will be performed to derive feasibility and cost data in order to assess the merits of hardware implementation and demonstration tests in a Phase II effort.

HYPRES, INC.
175 CLEARBROOK ROAD
ELMSFORD, NY 10523
Phone: (914) 592-1190
Topic#: 93-057
Office: ES3
Contract #: F19628-93-C-0099
PI: Dr. Oleg Mukhanov
ID#: 93ES3-161
Title: Superconducting Logic for Wideband Beamforming
Abstract: Current beamforming systems limited to digital processing at a basebands of typically less than 100MHz, restricted by 500MS/s Analog to Digital Convertors (ADC) and 100MS/s Digital Signal Processors. HYPRES proposes a promising new way to realize a digital beamformer based on true time delay elements and capable of ultra-wide bandwidth operation combined with arbitrarily large array size by using recently developed superconducting RSFQ digital technology. HYPRES has demonstrated the key elements required for a digital system, the operation of an 8-bit 20GS/s ADC capable of digitizing 1-18GHz input signals and superconducting logic capable of pipelined arithmetic functions at clock rates in excess of 20GHz. The digital wideband beamforming system proposed is required to perform the delay, multiply and sum functions necessary to implement the beamforming algorithm. The Phase I objective is to demonstrate the high-speed operation of the critical components of an extendible wideband digital beamforming system. Toward this goal, HYPRES will implement and test a 64-bit Variable-Length Shift Register and a Parallel Multiplier design operating at 10 to 20GHz. HYPRES proposes in Phase II to develop a digital wideband beamforming system. The proposed system would use a wideband ADC operating at up to 20GS/s for a 10GHz instantaneous bandwidth baseband. The system would use multiple copies of a single IC with a fast ADC and beamforming section. These ICs would be cascadable to any size array. For implementation of large spatial arrays, the IC would have an optical input, this would allow for many widely separated antennas. The IC would be 1cm x 1cm and dissipate less than 100mW, a complete 64 channel beamforming front-end system could be implemented on a single 6" substrate.

HYPRES, INC.
175 CLEARBROOK ROAD
ELMSFORD, NY 10523
Phone: (914) 592-1190
Topic#: 93-076
Office: PL1
Contract #: F29601-93-C-0046
PI: DR. ELIE K. TRACK
ID#: 93PL1-925
Title: Optically Linked Receiver

Abstract: Signal information can be transmitted over an optical fiber by encoding the signal as a frequency or phase modulated lightwave carrier. This approach eliminates the need for any light amplification if an adequately sensitive phase demodulator coupled to an analog-to-digital converter is used at the receiving end. A digital output is thus readily obtained. Phase modulation offers several advantages over intensity modulation: wider bandwidth, higher sensitivity, and wider dynamic range. The phase modulation can be produced by electro-optic materials without the need for any active devices. The signal carrier is mixed down and converted into an electrical signal by a fast PIN diode. The intermediate frequency (IF) is greater than the signal bandwidth and less than the diode cut-off, typically 5-50 GHz. The signal information exists as the frequency or phase variation of the IF. The IF frequency must be measured and converted to digital data at twice the signal bandwidth, up to 10 GS/s. HYPRES proposes a complete digital system to measure the IF signal content. The system detects the time-of-arrival of the zero-crossings of the IF. A very high sensitivity superconducting flux quantizer, already demonstrated by HYPRES, is used for this measurement. The quantizer is followed by a 100 GHz sampling system consisting of an accumulator and an averager. The combined system is capable of 1 ps resolution in the progressive phase acquisition, translating into a 20 GHz IF base interval, and corresponding to a signal bandwidth of 5 GHz with 6.7 bits of resolution. For a 0.5 GHz signal bandwidth, the signal resolution will be 10 bits. In Phase I, HYPRES will demonstrate the feasibility of the approach by generating and detecting the zero-crossing frequency of an optical signal. In Phase II, the complete link will be implemented with a signal bandwidth of 5 GHz.

HYPRES, INC.
175 CLEARBROOK ROAD
ELMSFORD, NY 10523
Phone: (914) 592-1190

Topic#: 93-113 ID#: 93WL2-065
Office: WL2
Contract #: F33615-93-C-1232
PI: Dr. Oleg Mukhanov

Title: Multi-GHz Superconducting Logic for Digital Signal Processing and Applications for Electronic Warfare systems

Abstract: Current Electronic Warfare (EW) systems are limited to digital processing at a baseband of typically less than 100MHz, restricted by 500MS/s Analog to Digital Convertors (ADC) and 100MS/s Digital Signal Processors. HYPRES proposes to develop the key components to allow the implementation of a digital EW system with a 10GHz instantaneous bandwidth baseband. This design would replace the analog components, except for an optional first level of down conversion, with an all digital system. HYPRES has demonstrated the key elements required for a digital EW system, the operation of an 8-bit 20GS/s ADC capable of digitizing 1-18GHz input signals and superconducting logic capable of pipelined arithmetic functions at clock rates in excess of 20GHz. Several EW system architecture's have been analyzed, and their analog architecture's have been translated to a digital implementation. The advantages of digital processing are significant; processing of an 10GHz instantaneous bandwidth for interception of spread spectrum and ultra-wideband signals, signal to noise ratio does not degrade through consecutive signal processing of the signal data stream, and SNR can be enhanced by rejection of out-of-band noise. This allows for post acquisition trade-off of bandwidth for resolution. HYPRES proposes in Phase I to design, fabricate and test the key digital element required by DSP algorithms, the multiplier accumulator (MAC). Using a serial design, a multiply accumulate requires only 33 Carry Save Adders, internally operating at 33GHz, that perform the multiply accumulate operation at 1 GHz. Phase II will develop a complete real-time spectrum channelizer suitable for insertion into an AN/ALR-56M from LORAL. The design consists of an 8-bit ADC operating at 1GS/s and a parallel 16-pt complex FET operating at 500MS/s.

ICET, INC.
916 PLEASANT ST., UNIT 12
NORWOOD, MA 02062
Phone: (617) 769-6064

Topic#: 93-064 ID#: 93PL1-165
Office: PL1
Contract #: F29601-93-C-0084
PI: DR.SRINIVASAN SARANGAPANI

Title: Electrode/Electrolyte Interfaces in Li/SPE Batteries

Abstract: All solid-state lithium secondary batteries have the potential to offer energy densities that are 4-5 times greater than the existing battery systems. However, several technological problems have to be solved before a full realization of their potential. The principal challenge is the stability of the solid polymer electrolytes (SPE). Currently, all lithium-SPE systems exhibit increasing cell impedance with cycles, leading to loss of capacity and poor cycle life. While the exact nature of the interfacial behavior is not yet well understood, it is clear that a proper understanding and elimination of the interfacial impedance problem is paramount to the development of long cycle-life lithium batteries. We propose an attempt to synthesize some truly ionic, lithium conducting polymers and the construction and study of all solid-state LixC6/SPE/Mn2O4 systems. A well

characterized PEO system as control will be compared to the new electrolyte systems with respect to conductivity and cell performance. The interfacial behavior of these electrolytes with both the electrodes will be studied using cross-sectional and morphological examinations, infrared spectroscopy and x-ray diffraction of cell components and impedance and other electrochemical behavior of the cells, all as a function to be determined by cycle intervals.

IGR ENTERPRISES, INC.
11000 CEDAR AVENUE
CLEVELAND, OH 44106
Phone: (216) 721-5511

Topic#: 93-011 ID#: 93AFC-166
Office: AFCESA
Contract #: FO8635-93-C-0103
PI: DR ARNOLD Z. GORDON

Title: Ceramic Composite Electrolytic Technology for Neutralization of NOx

Abstract: The overall objective of this SBIR project is to demonstrate the feasibility of a new all solid state electrochemical technology to remove air pollutants that can result from many types of Air Force ground based activities, including aircraft engine exhaust and spills and leakage of liquid rocket oxidizers.

INFRARED COMPONENTS CORP.
311 TURNER ST.
UTICA, NY 13501
Phone: (315) 732-5020

Topic#: 93-035 ID#: 93ES3-223
Office: ES3
Contract #: F19628-93-C-0123
PI: Joseph R. McCoy, PE

Title: Large Area Staring Array Cryogenic Packaging for Early Warning Systems

Abstract: AF ground based and airborne early warning systems are continuously demanding larger Staring Focal Plane Arrays (FPA's) to carry out their mission. Such large format Staring FPA's are currently under active investigation and development by the Air Force Rome Laboratory/Electromagnetics and Reliability Directorate (RL/ER). As Staring FPA formats increase, the package (Dewar) designer is faced with the ever-increasing difficult task of providing proper cooling within the system constraints. Infrared Components Corporation (ICC) has developed, manufactured, and successfully tested, proprietary designs for Integrated Detector Assemblies (IDAs.) We propose to carry out thermal, structural and temperature uniformity analyses and collect relevant cryocooler data for such large format FPA's. Based on the results of these tasks, and the existing ICC designs, a preliminary design will be carried out. This will be appropriate for demonstration of the cryogenic technologies in Phase II.

INNER HEALTH, INC.
27149 SHOREWOOD RD
RANCHO PALOS VERD, CA 90274
Phone: (310) 544-7115

Topic#: 93-023 ID#: 93AL -231
Office: AL
Contract #: F41624-93-C-6005
PI: Christopher Alsten,PhD

Title: Nonpharmacological Performance Enhancement and Fatigue Countermeasure

Abstract: Investigation of 3-D "Virtual Reality" audio enhanced techniques to increase efficacy and quality of sleep under adverse conditions and its implications for "Sleep Training." Sleep quality and quantity can significantly impact military performance. Due to the inherent side-effects of sedative-hypnotics there are many times when they cannot be used such as in-flight sleep during long hauls. Recently, significant strides may have been made in the nonpharmacological treatment of insomnia that may be of use in inducing and maintaining higher quality sleep than might otherwise be obtained under common stressful or adverse military conditions. Phase I will measure the quality and quantity of sleep obtained by crew chiefs on KC-10 aircraft via Medilog recordings. Actilume data will be obtained for the night preceding the mission through three nights post completion and sleep logs will be kept. Crew chiefs will undergo three different prototype "sleep training" regimes using nonpharmacological insomnia treatment techniques including a new 3-D "Virtual Reality" audio technology delivered via ordinary tape player and headphones. A repeated measures design using the same Medilog/Actilume protocol will evaluate effectiveness both on in-flight sleep and potential impact on sleep disrupted by circadian dysrhythn associated with long distance transmeridian flight.

INNOVATION ASSOC., INC.
P. O. BOX 1306
ANN ARBOR, MI 48106
Phone: (313) 995-9338

Topic#: 93-087 ID#: 93PL1-188
Office: PL1
Contract #: F29601-93-C-0058
PI: CHARLES LYSOGORSKI

Title: Aero-optical Wave-front Characterization System

Abstract: To provide the Air Force with the capability of measuring optical wave-front properties around aerodynamic structures in wind tunnels, Innovation Associates proposes to develop a high-speed, Aero-optical Wave-front Characterization System (AWCS) which is capable of recording 64,000 or higher wave-front phase measurements per second. AWCS will consist of three subsystems: (a) an innovative high speed image recording system capable of recording approximately 1000 wave-front measurements at 64 KHz onto an optical buffer; (b) a real-time interferometer capable of providing 256x256 resolution wave-front measurements per pulse; and (c) a pulsed copper vapor laser system capable of delivering 64 KHz illumination pulses/sec. After acquiring the wave-front data, a computer will digitize the stored data, archive it to an optical disk, and analyze it to generate wave-front phase maps and data on the spatial correlation and shape of turbulent regions in the boundary layer. The wave-front measurements will be synchronized with other wind tunnel diagnostics to provide a high temporal resolution link between the fluid mechanical and optical diagnostic measurements. During Phase I, Innovation Associates will demonstrate the feasibility of developing AWCS.

INSITEC, INC.
2110 OMEGA ROAD, SUITE D
SAN RAMON, CA 94583
Phone: (510) 837-1330

Topic#: 93-001 ID#: 93AED-019
Office: AEDC
Contract #: F40600-93-C-0002
PI: Donald J. Holve

Title: Instrument System for Monitoring Simulated Weather Generated Particulates

Abstract: The objective of this project is to develop a monitor which can evaluate the velocity, size, concentration, and spatial distribution of Weather Generated Particulates (WGP), including sand, ice, etc., under ground-based simulation conditions. Specific instrumentation requirements include the measurement of spherical or non-spherical, opaque or transparent particulates in the size range of 100 - 1000 micrometers. The concentration can vary from the PPM level (by volume) up to concentrations which simulate low visibility sandstorms. Velocities can range from zero to hypersonic mach numbers at flight environments ranging from sea level up to 200,000 foot altitude, which implies low pressures and freezing temperatures. Insitec proposes to use a combination of three real-time optical measurement methods to provide the required information. These light scattering techniques will be implemented in a prototype design which uses software and hardware concepts that have been previously developed and verified by Insitec. For Phase I, two Insitec instruments (PCSV and EPCS) will be available for preliminary testing under anticipated WPG conditions to show feasibility and to guide specific prototype development in Phase II.

INTEGRATED APPLIED PHYSICS, INC.
P.O.BOX 70166
PASADENA, CA 91117
Phone: (617) 489-1818

Topic#: 93-074 ID#: 93PL1-122
Office: PL1
Contract #: F29601-93-C-0043
PI: DR. GEORGE KIRKMAN

Title: High Current Ferroelectric Cathode Without A-K Gap Closure

Abstract: Electron sources with high emission current densities capable of operating in poor vacuum with A-K gap closure are required by electron beam experiments. Thermionic cathodes and field emission cathodes are limited by current density, high vacuum and high field requirement or degradation of vacuum when operated repetitively. We propose to design, build, and test a high current, high voltage ferroelectric cathode for microsecond pulse operation without A-K gap closure. Ferroelectric cathodes operate at room temperature using spontaneously polarized materials such as Pb(Zr,Ti)O3. Previous research at CERN, Cornell, and Integrated Applied Physics has demonstrated these cathodes to be sources of high current density, high quality electron beams. Emission of microsecond pulses has been observed. Previous research has also indicated good electron gun performance using the ferroelectric cathode at poor vacuum (~ 10^-3 Torr) without poisoning or A-K gap closure. During Phase I, we will demonstrate electron gun operation producing a beam of 5 cm radius up to 150 kV and 5kA, and test ferroelectric cathodes of different material compositions. Based on the Phase I work, an advanced cathode can be designed, built, and tested during Phase II to operate at 500 kV in microsecond pulses at high repetition rates.

76

INTEGRATED SENSORS, INC.
P.O. BOX 814
NEW HARTFORD, NY 13413
Phone: (315) 798-1377
Topic#: 93-114 ID#: 93WL2-076
Office: WL2
Contract #: F33615-93-C-1279
PI: Jeff Brandstadt
Title: Advanced Fire Control/Fusion Methods
Abstract: Technological advances in detector arrays, electronically scanned antennas, data links, and advanced processing hardware, are forcing sensor system designers, aircraft developers, and Air Force tacticians to rethink traditional sensor functionality and intra-flight tactics. Classical mission roles are changing. Where before, surveillance aircraft vectored autonomous interceptors, each relying on its own fire control radar to perform search, acquisition, track, and weapon guidance functions, now reconnaissance platforms, fighters and attack aircraft operate on a network that gives them the capability to execute stealthier, more cooperative roles. Smart intra-flight resource management allows the flight to cooperatively allocate sensor coverages, prioritize targets, mask equipment failures, assess the situation, and then adapt as the engagement evolves. Multisensor fusion and data internets do promise the benefits of quicker acquisition, more accurate tracks, improved weapon delivery, better system integrity, sensor management, and passive fire control. The challenge is to realize them in real time. Integrated Sensors, Incorporated (ISI) proposes optional Phase I plans that develop specific submodes of the internetted fighter mission. For any of the multisensor internetting programs proposed, ISI will define multisensor system and operational requirements, specific algorithms and software requirements, demonstrate sections of the submode on our real time, multisensor processing testbed to help estimate processing throughput requirements, and then provide results, analysis, and performance predictions. Each plan is formulated to allow for a seamless transition into Phase II where ISI will deliver fully functional multisensor software and real time demonstration hardware.

INTELLIGENT AUTOMATION, INC.
1370 PICCARD DR., SUITE 210
ROCKVILLE, MD 20850
Phone: (301) 990-2407
Topic#: 93-070 ID#: 93PL1-070
Office: PL1
Contract #: F29601-93-C-0096
PI: DR. ZHENG GENG
Title: Six Degree of Freedom Active/Passive Launch Isolation System
Abstract: Intelligent Automation, Incorporated, has demonstrated a six degree of freedom vibration control system capable of providing active structural vibration control and vibration isolation. Our work differs from the enormous wealth of work already done in active vibration isolation because our work focuses on six degree of freedom vibration isolation. Mechanically, our system uses a unique configuration which decouples the motion in each of the six degrees of freedom. The actuators we developed exploit magnetostrictive material and therefore have higher force capability and longer stroke than piezoelectric actuators which are conventionally used, and magnetostrictive material has no known deterioration with age (while piezoelectrics are known to deteriorate with age). Algorithmically, we developed an adaptive filter approach to six degree of freedom vibration isolation which dynamically learns the characteristics of the host structure. Experimental hardware was built and tested. Our system obtains 30 dBs of attenuation in the accelerations measured on the isolated structure when the active control system was operating. This proposal details how we will apply and extend our previous results to active/passive launch payload isolation systems.

INTERMAT
6100 VIRGINIA DRIVE
AUBURN, CA 95602
Phone: (916) 878-7431
Topic#: 93-136 ID#: 93WL5-089
Office: WL5
Contract #: F33615-93-C-5385
PI: Walter Schmidt
Title: Sapphire Fiber Developmental Program for High Temperature Composites
Abstract: Recent developments in composites based on aluminides of titanium and nickel have shown the need for novel methods of production for cost effective methods of manufacture for continuous and discontinuous reinforcement materials. Currently, such materials as SiC provide a source of matrix fiber. In projected applications for aluminides, desirable characteristics of reinforcing fibers are compatible coefficient of expansion (CTE) with the matrix, good oxidation resistance, high tensile strength at elevated temperatures and mass production feasibility, while remaining cost effective. Much work has been dedicated to development of discontinuous short whisker and continuous fibers of alumina and sapphire. The CTE of aluminides is more than twice that of SiC, while Aluminum Oxide more closely approaches that of potential matrix materials. What we propose is the development of a complete process in growing long whiskers of sufficient lengths to spin into multi-strand thread. Further,

to treat the thread via a newly developed process to further strengthen the physical characteristics such as hardness, tensile, and compressive strength. Such a process to change the wetting characteristics of the thread making it more compatible with metallization, bonding to plastics and other ceramics. The completed thread may be woven into MAT as matrix reinforcement.

INTERSCIENCE, INC.
105 JORDAN RD
TROY, NY 12180
Phone: (518) 283-7500
Topic#: 93-127 ID#: 93WL4-067
Office: WL4
Contract #: F33615-93-C-3002
PI: Dr. James Castracane
Title: Multi-element Wind Tunnel Probe for Hypersonic Flow Diagnosis
Abstract: For the accurate analysis of hypersonic flows in wind tunnels, it is necessary to have precise measurements of the flow profiles to better understand the effects of short scale length turbulence. Current methods are lacking in time response, durability and reproducability. The development of a durable, optically based sensor array capable of spatially resolved, real time pressure profile fluctuation measurements is proposed. From these measurements, thermodynamic fluctuations may be derived. The innovative features of the Multi-element Wind Tunnel Probe (MWTP) are two fold. First, the signals are based on optical effects for fast response and high resolution. Second, the transducer array will be fabricated using semi-conductor manufacturing techniques and will be coated with diamond-like films for protection against high temperature, corrosive wind tunnel conditions. Design of a compact probe with multiple sensors is proposed in Phase I. Prototype demonstrations of the critical components will be done. Through the use of such a system, high temporally and spatially resolved measurements may be made in hostile environments. The importance of this innovation is its impact on aerospace research and in particular, as a powerful new diagnostic for wind tunnel studies.

JET PROCESS CORP.
25 SCIENCE PARK
NEW HAVEN, CT 06511
Phone: (203) 786-5130
Topic#: 93-153 ID#: 93WL6-197
Office: WL6
Contract #: F33615-93-C-2347
PI: DR BRET L. HALPERN
Title: Advanced Coating Technology for High Performance Gas Turbine Components
Abstract: We proposed in collaboration with Pratt & Whitney to develop advanced coating technology for high-performance gas turbine components, utilizing our innovative, patented, pollution-free, low cost Jet Vapor Deposition process. The JVD process uses supersonic jets in "low vacuum" to propel atoms, molecules, or clusters toward substrates. JVD offers: (1) extremely high rates of concentrated, efficient deposition; (2) low vacuum operation which simplifies automation versus high vacuum PVD systems; low temperature, ion-assisted processing permitting deposition on thermally sensitive substrates; (3) capability for high rate "reactive" formation of alloys, intermetallics, compounds and multi-layer nanostructures. Pratt & Whitney has selected two promising applications for development: i) Titanium-nitride based erosion-resistant coatings on fan and compressor components; and ii) Multi-layer, nickel-aluminide nanostructured coatings for service as strong, crack-resistant, thermally-durable, oxidation-barriers on turbine airfoils. JPC will prepare experimental JVD coatings on test "coupons" provided by P&W. P&W will then test these coatings using standard techniques. JPC and P&W will meet to jointly evaluate coating test results and projected economics of JVD manufacturing processes. JPC and P&W will then assess prospective costs and performance benefits of JVD coating technologies for advanced jet engine applications.

KACHINA TECHNOLOGIES, INC.
1420 CARLISLE NE, SUITE 202
ALBUQUERQUE, NE 87110
Phone: (505) 268-8982
Topic#: 93-172 ID#: 93WL0-139
Office: WL0
Contract #: F08630-93-C-0041
PI: Robert A. Ballance, Ph.D.
Title: Embedded Continuum Codes in Vulnerability Assessments
Abstract: Targets designed to withstand the effects of conventional (non-nuclear) munitions are assessed using standard vulnerability assessment methods. These assessment tools usually consider variabilities in site characteristics, target attributes like strength and stiffness, and weapon delivery characteristics. Current vulnerability procedures are overly conservative in that, to ensure high confidence in sustaining the facilities' mission, they presume a "worst-case scenario" in the use of values for target strength or weapon CEP. The problem is compounded by the fact that the loading on a target is caused by a weapon environment whose effects on the target are highly variable, and where significant changes in some parameters can require a

complete change in the vulnerability model. Our Phase I research objective is to demonstrate the powerful capabilities of an object-oriented framework approach, by building a software environment to conduct embedded simulation exercises for assessment. We will demonstrate the software environment by implementing into our framework two or three simple existing two-dimensional continuum codes running on a single hardware architecture and integrated with one or two simple vulnerability codes.

KENTERPRICE RESEARCH, INC.
23 SOUTH HARLAN ST
YORK, PA 17402
Phone: (717) 848-4528
Topic#: 93-011 ID#: 93AFC-046
Office: AFCESA
Contract #: FO8635-93-C-0102
PI: JAMES KEANE
Title: Enhancement of Membrane-like-material Direct-nucleate-flotation with Four Experiments
Abstract: Two new families of liquid membranes have been developed for cleaning oily waste water and removing dissolved solids from water. One, called Membrane-Like-Material (MLM) is formed using chlorinated solvents, which are solvents removed to far below their solubility in water. The dissolved materials in the water are not removed by the MLM and a second system based on surfactant mono-layers on air bubbles coated with the ions of Alum and Sodium Hydroxide is used to effect the separation of heavy metals from water. It is proposed that these two processes be combined to use the same hardware to use both at the same time. Since the chemistry of each is not effective with the other, this should be possible. Thus, materials such as TCE in the presence of heavy metals in the water can be processed with a single treatment stage as one unit process only. In addition, the TCE is used to remove itself from the water, and once started the process will continue with recovered TCE. Four experiments are proposed to improve various aspects of these two technologies. The Bubble Generation of mono-layer bubbles has a lot of development room left. The MLM process could perhaps be done in the vapor phase, and dilute aqueous MLM solvent systems are known to exist. Any or all of these avenues of improvement will lead to less equipment being required.

KESTREL DEVELOPMENT CORP.
3260 HILLVIEW AVENUE
PALO ALTO, CA 94304
Phone: (415) 493-6871
Topic#: 93-058 ID#: 93ES3-181
Office: ES3
Contract #: F30602-93-C-0150
PI: Dr. Allen T. Goldberg
Title: Design Verification and Transformation of Hardware Specifications to VHDL
Abstract: Our innovative proposal is to apply the design refinement approach, as implemented in the Reacto Verification System (RVS), to construct verified VHDL models. RVS includes a specification language, with features fundamental to the specification of hardware systems, a graphical interface used to construct specifications; a verification subsystem that includes a verification condition generator, and a state-of-the-art theorem prover integrated into a comprehensive verification environment; a simulator used to rapid prototype a specification; and a transformation system used to transform specifications into target code using transformations formally proved to be correctness preserving. We propose to perform design studies to define extensions to RVS for the specification and generation of VHDL hardware descriptions. These extensions include the construction of a VHDL back-end to the transformation system, and extensions to the specification language, simulation environment, and verification environment. The design study will analyze one significant sample problem: a hardware implementation of the Data Encryption Standard (DES) algorithm. RVS leverages off of and contributes to the considerable technology base available at Kestrel. This project will be done in cooperation with Capt. Paul Bailor of AFIT.

KNOWLEDGE BASED SYSTEMS, INC.
ONE KBSI PLACE, 1408 UNIVERSITY DRIVE EAST
COLLEGE STATION, TX 77840
Phone: (409) 260-5274
Topic#: 93-023 ID#: 93AL -211
Office: AL
Contract #: F41624-93-C-5008
PI: Arthur Keen
Title: Conversion of Scanned Engineering Drawings to Product Data Descriptions
Abstract: Despite the popularity of CAD/CAM systems today, over 90% of all drawings in the U.S. are not computer processable as they exist only in paper or microfilm. Without the development of technology to convert raster drawing to product data model, this situation is likely to persist for some time as over 50% of all new drawings are still being executed on paper. This vast backlog of manual drawings is a serious problem to logistic support as most engineering projects involve

79

incremental changes to, or reuse of components in existing designs. The current practice of overlaying vector drawings on top of raster images necessitates investment in vast amounts of persistent data storage. Raster images cannot be used with modern CAD/CAM/CAE systems. This proposal describes a system that will input information from a raster to vector converter, and with human assistance, output produce-data models (PDES). The system uses an approach that takes advantage of connectionist techniques (Neural nets and Fuzzy logic) with traditional knowledge-based techniques. A three-phase process is used: 1) recognition of abstract topological patterns, 2) hypothesizing product data prototypes for these abstract patterns, and 3) validation of prototype shapes within the context of the evolving product-data model using constraint propagation.

KNOWLEDGE BASED SYSTEMS, INC.
ONE KBSI PLACE, 1408 UNIVERSITY DRIVE EAST
COLLEGE STATION, TX 77801
Phone: (409) 260-5274
Topic#: 93-040 ID#: 93ES2-144
Office: ES2
Contract #: F19628-93-C-0154
PI: Dr. Perakath Benjamin
Title: Cost Benefit Analysis Support Environment
Abstract: The ultimate goal of this project is to develop a production version Cost Benefit Analysis Support Environment (CBASE) for C4 applications. The objectives of the Phase I project are: (i) establish viability of IDEF0 and IDEF3 for ABC-based cost analysis, (ii) investigate integration of IDEF0 and IDEF3 for cost analysis support, (iii) develop qualitative and quantitative cost benefit mechanisms using IDEF models, (iv) investigate model change propagation strategies for cost control, and (v) design and build prototype CBASE. The research adopts an innovative integration-driven approach to develop cost analysis support. The following activities will be undertaken to accomplish the project objectives: (i) develop mechanisms to integrate IDEF0 and IDEF3 models for the purpose of cost analysis, (iii) develop qualitative cost analysis mechanisms developed around IDEF3-based activations, (iv) investigate the use of the constraint propagation paradigm for monitoring and maintaining model changes, (v) demonstrate technical viability of the research by building a proof of concept CBASE system, and (vi) write a detailed Phase II plan. The results of this research have the potential to significantly impact cost management methodologies of the future.

KSE, INC.
P.O. BOX 368
AMHERST, MA 01004
Phone: (413) 549-5506
Topic#: 93-011 ID#: 93AFC-107
Office: AFCESA
Contract #: FO8635-93-C-0087
PI: DR J. R. KITTRELL
Title: Air Process for Control of Dilute air Emissions of Chlorinated Hydrocarbons
Abstract: In the control of air pollution on military bases, increasing emphasis is needed for technologies applicable to dilute concentrations of pollutants in air. For example, the control of indoor air pollution associated with solvent degreasing operations is necessary, including the dilute emissions associated with exhaust ventilation fans. Air stripping of contaminated groundwater often produces dilute emissions for which current destruction technology provides no economic solutions. Activated carbon adsorption could be used, but is often uneconomical for these cases and can create a hazardous solid waste which is increasingly difficult to manage. In the proposed research, the technical feasibility is to be established of integrating a highly effective adsorbent with catalyzed ultraviolet (UV) oxidation to obtain a novel dilute phase air pollution control process. This Adsorption Integrated Reaction (AIR) Process concentrates organics on an adsorbent transparent to UV light. The contaminant is then catalytically destroyed at high selectivity. The feasibility study is to be conducted with chlorinated compounds, but the AIR process should also be applicable to volatile organic compounds emissions control.

KTECH CORP.
901 PENNSYLVANIA AVE. NE
ALBUQUERQUE, NM 87110
Phone: (301) 863-7276
Topic#: 93-077 ID#: 93PL1-184
Office: PL1
Contract #: F29601-93-C-0049
PI: FREDDIE W. SMITH
Title: Combination Microwave Circuit Analysis and Coupling Code
Abstract: Ktech proposes to perform research and define a program plan for integrating a time domain finite difference electromagnetic solver with a circuit analysis code. The resultant computer code will be able to consistently self-solve for the induced voltages and currents on circuit board components for a given threat electromagnetic environment A novel approach on the modelling requirements for addressing the high power microwave threat is presented. Also a novel approach for

modelling thin walls is presented. The resultant code would not only improve the capability of the standard electromagnetic solver, but also improve the codes accuracy, especially with high frequency incident electromagnetic fields.

KURT J. LESKER COMPANY
1515 WORTHINGTON AVENUE
CLAIRTON, PA 15025
Phone: (412) 233-4200

Topic#: 93-047
Office: ES3
Contract #: F19628-93-C-0138
PI: Michele Migliuolo, Ph.D.

ID#: 93ES3-072

Title: Integrated Multi-vessel Surface Process System For Optical Device Fabrication

Abstract: We propose to provide a set of general design drawings describing a multi-vessel UHV growth and surface analysis system which is based on the concept of central distribution sample handling. The type of UHV system discussed in this proposal is of interest because electronic and optical device fabrication techniques have suffered from difficulties arising from the need to analyze device parameters during growth or right after growth. The simplest system configuration includes a growth chamber, a sample transfer chamber which holds the central distribution sample handling device, and a surface analysis chamber. Full system integration in terms of mechanical design and sample transfer efficiency will be assured through expert design and engineering.

LASER DATA TECHNOLOGY, INC.
9375 DIELMAN INDUSTRIAL DR.
ST. LOUIS, MO 63132
Phone: (314) 997-2250

Topic#: 93-088
Office: PL1
Contract #: F29601-93-C-0175
PI: ERNEST S. CLARK

ID#: 93PL1-053

Title: High-power Fiber-coupled Semi-conductor Laser Source

Abstract: A six-month effort is proposed to utilize the author's expertise in semi-conductor laser diodes and fiber-optic technology to develop a design for a 50 to 100 watt fiber-coupled laser-diode source. A proprietary technique is described for achieving high power and high power density in the fiber which makes the most efficient use of the laser energy in a bar. The approach taken will use the fewest diode bars, which achieves the lowest production costs. The Phase I effort will produce a deliverable prototype for a 10-watt-cw output power, as well as a final report containing the design details for the higher power system. The fiber-coupled output power of the prototype will be concentrated in a fiber 300um in diameter, and the 50 to 100 watt-cw output of the Phase II design will be concentrated in a 500um diameter fiber for a power density above 25kw/cm sq. The design approach taken enables low cost production, which, in turn, opens applications heretofore prohibitively expensive.

LASER PHONOTICS TECHNOLOGY, INC.
1576 SWEET HOME ROAD
AMHERST, NY 14228
Phone: (716) 688-8251

Topic#: 93-016
Office: AFOSR
Contract #: FQ8671-9301301
PI: Yue Zhang

ID#: 93AFO-075

Title: A New Class of Novel Non-linear Optical Materials for Real-time Quasi Phase-matched Second Harmonic Generation and Beam Steering Devices

Abstract: Second-harmonic generation, electrooptic modulation and optical beam steering are among the most important applications of second-order non-linear optical processes. A new concept in the design of novel non-linear optical materials is proposed in which second order chromophores are incorporated in polymers with low glass transition temperatures (Tg). Quasi phase-matched second-harmonic generation in such materials can be realized by periodically poling the chromophores in the direction of the electric field; there is no SHG in the absence of the poling fields. Optical beam steering can also be realized due to the change in the refractive index of the film caused by the applied electric fields. The proposed polymers possess low glass transition temperatures that allow the small chromophore molecules to reorient under the presence of an applied electric field. The requirements for the active chromophore molecules include high hyperpolarizability, B, small size, and ease of processability. The large molecular hyperpolarizability provides higher second-order non-linear optical responses when aligned in the direction of the poling electric field. The small size of the dopant molecules and the low glass transition temperature of the host medium will ensure facile reorientation of these molecules under the applied electric field, fast non-linear optical response and large change in refractive index. The time scale for the response can be expected to be microseconds or faster.

LASER POWER CORP.
12777 HIGH BLUFF RD.
SAN DIEGO, CA 92130
Phone: (619) 755-0700
Topic#: 93-084 ID#: 93PL1-075
Office: PL1
Contract #: F29601-93-C-0107
PI: DR. MAURICE PESSOT
Title: Diode Pumped Parametric Oscillator
Abstract: Direct pumping of an OPO by diode laser represents the most desirable and most efficient configuration for a parametric source in the mid-infrared. Combining recent advances in single frequency diode lasers with advanced non-linear materials offering advantageous phase matching properties, we propose to demonstrate a parametric oscillator directly pumped by a laser diode. As state-of-the-art diode laser pump sources provide sw and quasi-cw output, the parametric oscillator will operate in a cw or long pulse regime. In contrast to previous cw parametric oscillators, the system will rely on non-degenerate operation of the OPO, thus providing 2 distinct output wavelengths, with the signal and/or idler output lying in a region of high atmospheric transmission. Our design utilizes a non-critically phase matched interaction in silver thiogallate, AgGaS sub2 , to achieve a long interaction length and low threshold. Singly a resonant operation as well as a lower threshold doubly resonant system will be explored. Following the evaluation of various pump/oscillator designs, the proposed Phase I program includes a series of risk reduction experiments to verify the baseline design and choice of non-linear gain medium. These experiments include the demonstration of a cw pumped doubly resonant OPO.

LASER-MATTER INTERACTION LABS
1423 MADISON NE
ALBUQUERQUE, NM 87110
Phone: (505) 277-4650
Topic#: 93-134 ID#: 93WL5-057
Office: WL5
Contract #: F33615-93-C-5340
PI: Dr Anadi Mukherjee
Title: Novel Composite Organic/Polymeric Materials for Visible Light Emission
Abstract: Several dye-doped polymer waveguides are selected based on a new integrated infrared to visible up-conversion scheme. Visible up-conversion particularly at blue, green and red wavelengths will be searched in these materials. Thin films of these materials will be spin coated and a simple laser polymerization process will be used to fabricate waveguides with low linear optical loss. Non-linear optical characterization of these materials will be done from infrared two-photon absorption coefficient, cross section and up-conversion yield measurements. These materials will be evaluated and compared for visible up-conversion applications with the help of a new figure of merit. Stimulated emission in the visible wavelengths will be demonstrated in these waveguides in the form of amplified spontaneous emission.

LASERTRON, INC.
23 FOURTH AVE.
BURLINGTON, MA 01803
Phone: (617) 272-6462
Topic#: 93-035 ID#: 93ES3-222
Office: ES3
Contract #: F19628-93-C-0118
PI: Richard Panock
Title: Low Loss 18GHz Fiber Optic Link
Abstract: Currently, wide bandwidth, microwave fiber optic links suffer from excessive loss due to the poor conversion efficiency of laser drive current to photo-detector signal current. An additional disadvantage of this high loss is a relatively poor noise figure for the microwave link. These fiber optic links would be more easily used in many applications if this link loss could be significantly reduced. Several methods have been proposed to more effectively couple the RF input power to the laser diode microwave frequencies over wide bandwidth, both passively and actively, but none have been demonstrated. In this work we will design a passive, wide bandwidth matching network that combines a microstrip transformer along with a lumped element transformer to match a 50ohm system to a 4ohm laser diode. Improvement in electrical link loss is expected to be 10dB. Additionally, we will study the feasibility of developing wide bandwidth active matching circuits to further reduce electrical link loss. This study will include both lumped and distributed amplifier techniques. The anticipated link loss improvement will be 20dB over resistive matching to the laser diode. The expected bandwidth is 6 to 18 GHz.

LASERTRON, INC.
37 NORTH AVENUE
BURLINGTON, MA 01803
Phone: (617) 272-6462
Topic#: 93-054 ID#: 93ES3-134
Office: ES3
Contract #: F19628-93-C-0096
PI: D. A. Atlas

Title: Strained-layer Quantum-well Laser Structures For Microwave Applications
Abstract: Due to the enhanced differential quantum efficiency, high differential gain and potential low laser relative intensity noise of strained Quantum Well (QW) lasers, there is a significant opportunity to develop fiber optic links that employ QW lasers which may exceed the current link loss and noise figure performance of bulk laser based links. While high speed (>20GHz) strained layer QW lasers operating at short wavelengths have been demonstrated, no QW devices have yet been made that operate above 17GHz at 1.3um or 1.5um wavelength. This program will investigate the feasibility of developing, packaging and characterizing long wavelength (1.3um and 1.5um) 25GHz modulation bandwidth strained QW lasers for microwave and millimeterwave transmission applications. In particular, the effort will use existing QW material and laser structure models to optimize the modulation bandwidth of lasers that employ innovative InGaAs(P)/InP and InGaAlAs QW material systems. Furthermore, we will evaluate our existing laser packaging up to 25GHz and determine if improvements are required to realize the potential bandwidth of the new laser structure in a commercial microwave fiber optic transmitter/link.

LEXITEK
10 TOWER OFFICE PARK, SUITE 304
WOBURN, MA 01801
Phone: (617) 933-0613
Topic#: 93-081 ID#: 93PL1-928
Office: PL1
Contract #: F29601-93-C-0064
PI: STEVEN M. EBSTEIN
Title: Thick Aberrator Compensation Using Phase Diversity
Abstract: The study of a method of imaging through thick turbulent layers using extended sources is proposed. The method uses the technique of phase diversity to generate multiple images of the source in multiple focal planes. A parametric description of the turbulent distortion and the source is found by a multidimensional fit of the data to a model of the turbulent distortion and the extended source. The phase diversity method simultaneously solves for the phase distortion (as a function of look angle) and the source distribution. In addition to the estimate of the source, the information can be fed back into an adaptive optics control system. The phase distortion can be parameterized in the pupil plane as a function of look angle or in a layered model where the layers sit at different distances from the pupil. Either model lends itself to estimation of the correcting phase to be applied at each element of a multi-conjugate adaptive optics system that corrects for an isoplanatic distortion. This method has application to imaging systems with synthetic beacons and passive systems that only use ambient light.

LIGHTWAVE ELECTRONICS CORP.
1161 SAN ANTONIO RD.
MOUNTAIN VIEW, CA 94043
Phone: (415) 962-0755
Topic#: 93-088 ID#: 93PL1-153
Office: PL1
Contract #: F29601-93-C-0104
PI: DR. WLLIAM M. GROSSMAN
Title: Compact Fiber-coupled Semi-conductor Laser Modules
Abstract: Applications of semi-conductor lasers such as making a portable medical laser pack for field use require a compact power fiber-delivered light source. A problem with present fiber-delivered semi-conductor laser sources is reliability, particularly at the fiber coupling or fiber connection areas where high optical powers can incinerate the connections. This proposal is for a feasibility demonstration of a fiber delivered source with emphasis on key optical connection technology. In Phase I we propose to use our existing 15 watt fiber-delivered sources to test detachable and replaceable fiber connections that potentially make these sources useful for medical applications. Phase II will develop and deliver complete sources to Phillips Labs, and extend present designs to higher powers. Our fiber's relatively low output divergence of under 30 degrees (measured to the 1/e2 intensity points) and small 400 um diameter permits high intensity focusing as well as low-loss power transmission over long distances.

LINCOM CORP.
5110 W. GOLDLEAF CIRCLE, SUITE 330
LOS ANGELES, CA 90056
Phone: (213) 293-3001
Topic#: 93-098 ID#: 93PL4-021
Office: PL4
Contract #: F19628-93-C-0072
PI: Steve Kuh
Title: Multipath Mitigation Technique for GPS Signal
Abstract: The objectives of this project are to study a multipath mitigation technique for the GPS receiver in Phase I and to build an engineering model and demonstrate the performance in Phase II. Using an innovative baseband digital signal processing technique, it is possible to provide real time and adaptive multipath correction for GPS ranging applications. Expected results

from Phase I work are: 1) feasibility of the multipath mitigation technique 2) preliminary design and complexity assessment of the device for digital VLSI implementation.

LITHIUM ENERGY ASSOC., INC.
225 CRESCENT STREET
WALTHAM, MA 02154
Phone: (617) 894-1510

Topic#: 93-148
Office: WL6
Contract #: F33615-93-C-2316
PI: FREDERICK DAMPIER

ID#: 93WL6-026

Title: Advanced Lithium Rechargeable Battery for Aircrew Survival Equipment

Abstract: This project will evaluate the low temperature (to -55 degrees C) performance of the $Li/CuCl_2$ and $Li/LixCo0_2$ rechargeable cells with SO_2 electrolytes to determine if one of these battery systems should be developed as a power source for aircrew survival-rescue equipment. The excellent cycle life and specific energy (e.g. 200 deep cycles at 165 Whr/Kg), wide operating temperature range, low self-discharge rate and ruggedness make the $Li/CuCl_2$ system particularly attractive for such an application. The approach in Phase I will be to characterize the low temperature 1.1 mA/cm^2 continuous discharge and 10-50 mA/cm^2 pulse discharge performance of 80 mAhr size laboratory cells at 23, -20 and -55 degrees C and then to evaluate the performance again after a number of innovative improvements to the positive electrode, electrolyte and cell design. Innovations that will receive particular emphasis will include reducing the particle size of the positive electrode active materials and conductive additives, modifying the crystal structure or purity of the active material and changing the electrolyte salt and adding volatile co-solvents. The construction and testing of rechargeable cells with 7.6 cm diameter bipolar electrodes will be undertaken to evaluate the merits of the bipolar electrode design as a means to increase the volumetric energy density for low temperature applications.

LME, INC.
201 DEFENSE HIGHWAY, SUITE 201
ANNAPOLIS, MD 21401
Phone: (215) 674-5881

Topic#: 93-023
Office: AL
Contract #: F41624-93-C-6010
PI: Barry Shope

ID#: 93AL -238

Title: Spinal Pre-loading Catapult for Escape Systems for ALCF

Abstract: Some of the advantages of the Spinal Pre-loading Catapult are given and the theoretical basis for its design is provided. The results of a study indicate improved performance levels that can be expected from the Spinal Pre-Loading Catapult are discussed. Utilization of a computer model of a preliminary two stage catapult design providing a measure of Spinal Pre-Loading is provided. The importance of developing a more capable computer model of the two stage catapult design with optimization potential is indicated.

LOGOS, INC.
8 MACKINTOSH LANE
LINCOLN, MA 01733
Phone: (617) 444-7892

Topic#: 92-031
Office: ESD
Contract #: F19628-93-C-0048
PI: JUDITH G. BRODMAN

ID#: 92ES2-059

Title: Return-on-investment (ROI) Model for SW Process Improvement Initiatives

Abstract: In assessing future DoD software demands, the US Air Force recognized the need for productivity increases and quality improvements in the computer software development process. To this end, the Software Engineering Institute developed a Capability Maturity Model and companion questionnaire to provide industry with guidance in improving the software development process in software organizations. However, without readily available return-on-investment (ROI) data to justify a company's investment in adopting the model, acceptance has been slow. A recent survey of over 30 firms (primarily DoD) has highlighted the reluctance of industry, without such ROI figures, to accept the DoD's imposition of ever increasing requirements for software process maturity among its contractors. Phase I of this proposal will determine the feasibility of developing a standard model and an industry-wide process improvement data base for computing a software organization's ROI for dollars spent on improving its software development process and for predicting costs for moving to higher levels of maturity. The model and supporting data base, both to be developed in Phase II, will provide managers with an automated tool to assess the cost impact of allocating dollars to various process improvement activities.

84

LYNNE GILFILLAN ASSOC., INC.
12699 SABASTIAN DRIVE
FAIRFAX, VA 22030
Phone: (703) 815-2373
Topic#: 93-161 ID#: 93XRX-041
Office: XRX
Contract #: F33657-93-C-2329
PI: Patricia A. Craig-Hart
Title: The Military Acquisition Decision Support System (MADSS)
Abstract: Acquisition managers in Premilestone I Acquisition activities face the task of identifying, defining, and selecting system concepts, and predicting which technologies will best support future acquisitions. A requirement exists for an automated tool which will gather and organize information, facilitate documentation of alternative concepts, tie the components of these alternatives to other information, and support prioritizing of these concepts. LGA has developed an approach to automated planning for R&D organizations, called the Roadmap Information Management System (RIMS). RIMS provides graphical and hierarchical representations of user-defined concepts called Concept Roadmaps. The Concept Roadmaps permit decision makers to document current capabilities, goal capabilities, and subgoals that have to be accomplished to reach their goal. Alternative concepts are represented either as "alternate paths" in a single Roadmap or in separate Concept Roadmaps within a single roadmap set. Concept Roadmaps are tied to a database containing other decision-related information. We are proposing to modify the approach used for RIMS to support the additional requirements identified for military acquisition decision support. The proposed Military Acquisition Decision Support System (MADSS) will consist of Concept Roadmaps and linked databases augmented with expert systems to assist in setting priorities and deciding among alternatives.

M.S. SAPUPPO & ASSOC.
7 REGIS ROAD
ANDOVER, MA 01810
Phone: (508) 475-3658
Topic#: 93-104 ID#: 93PL6-013
Office: PL6
Contract #: F04704-93-C-0004
PI: M.S. Sapuppo
Title: Manufacture of Precision Laminations/Cores by Millimachining
Abstract: Current fabrication and assembly methods for precision stator and rotor laminations/cores used in strategic guidance system components are costly, labor intensive, and stress sensitive procedures. Traditional methods used are pushed to the limit of their state-of-the-art to achieve the high quality standards required of both physical structure and electromagnetic properties. This Phase I proposal examines the applicability of modern millimachining technology to the manufacture of these precision laminations/cores. Millimachining is basically a 1000 times scale up of micro-machining technology. As such, macro-size structures can be made stress free while maintaining the inherent advantages associated with micro-machining such as - high resolution lithography, batch processing, wide choice of materials for etching or layering, and flexibility with use of other in-process technologies. This suggests cost, performance, and new capability advantages are possible with this approach. Initially, simple structures will be made to assess quality of nickel-iron alloy formed by millimachining. Experiments will follow to evaluate process control of critical geometric parameters. Finally a continuous process of fabrication will be evaluated to make a finished core. If this investigation proves successful, a Phase II will be proposed to manufacture rotor and stator laminations/cores for approval by Air Force Design Agency.

MAGNA PHYSICS DIV OF TRIDELTA IND
100 HOMESTEAD AVE
HILLSBORO, OH 45133
Phone: (513) 393-9835
Topic#: 93-146 ID#: 93WL6-230
Office: WL6
Contract #: F33615-93-C-2309
PI: JAMES R. HENDERSHOT, JR
Title: Switched Reluctance Machines for Gas Turbine Starter/Generators, Fuel Pumps and Flight Control Actuators
Abstract: The project proposed involves the detailed design, thermal analysis and performance simulation of Switched Reluctance electric machines for principle applications for the More-Electric-Aircraft. Considerable published data for gas turbine electric accessory motors has been addressed to base line applications for trade study analysis. The effort proposed for this project is more specific as related to actual applications such as being considered for the ATF programs (actuators and pumps) and disposable high speed gas turbines (starter/generators). The work would compare 3, 4 and 5 phase SR machines for each application, make a selection and perform a detailed design for each. Actual engine, pump and actuator vendors would be used for collaboration and integration of SR machine designs into actual engines, pump and actuators selected. The intent of the design study would be to select existing or future applications using a specific engine and specific pumps to develop an accurate sizing using thermal modeling, static simulation and dynamic simulation. The resulting designs would be considered for actual hardware fabrication and testing in a Phase II program in conjunction with engine and pump vendors. The SR machines for

(85)

these MEA applications could then be considered as available hardware for applications.

MAINE RESEARCH & TECHNOLOGY
P.O. BOX 353
SANFORD, ME 04073
Phone: (617) 233-5628
Topic#: 93-011 ID#: 93AFC-149
Office: AFCESA
Contract #: FO8635-93-C-0091
PI: DR MILAN TEKULA
Title: Optical Pollutant Monitor
Abstract: There exist many waste sites where the detailed characterization of the contamination needs to be performed to determine whether or not active remediation is necessary. These tests should be performed in situ since many of the contaminants are volatile. In addition, some of the sites are contaminated with radioactive waste, making in-site detection of contaminants difficult because the detectors become damaged by the radioactivity. Also, disposing of radioactive samples brought to the surface for analysis may be difficult. Monitoring of waste sites is important to determine which sites pose a health hazard as well as to determine which remediated sites no longer pose one. A device which uses a laser for the detection of the contaminant and fiber optics for the transport of the signals to and from the sample will be discussed in this proposal. This detector will be capable of working in a radioactive environment and will provide the investigator with an in-situ, rapid, non-invasive method of simultaneously measuring the presence as well as the concentration of multiple contaminants.

MAINSTREAM ENGINEERING CORP.
200 YELLOW PLACE
ROCKLEDGE, FL 32955
Phone: (407) 631-3550
Topic#: 93-009 ID#: 93AFC-034
Office: AFCESA
Contract #: FO8635-93-C-0112
PI: CLYDE F. PARRISH
Title: Improved Formulation of Fire Fighting Agents for Hydrocarbon Fires
Abstract: This Phase I effort describes Mainstream's innovative approach for the development of improved aqueous film forming (AFFF) fire fighting agents designed for hydrocarbon fires. This approach addresses the problem of biodegradability and performance of the current AFFF in extinguishing rolling fuel fires and its efficiency for securing the fire after its initial extinguishment. Under Phase I we will establish the parameters for developing a fire suppression agent with the capability of extinguishing rolling fires in flight operations. Then use Mainstream's experience with its computational chemistry software, ADAPT, to screen surfactants currently commercially available for their performance as a fire suppression agent. The Phase II effort will develop a surfactant formulation that enhances the fire fighting capabilities of the present technology, does not contain fluorosurfactants, and has less impact on the environment.

MAINSTREAM ENGINEERING CORP.
200 YELLOW PLACE
ROCKLEDGE, FL 32955
Phone: (407) 631-3550
Topic#: 93-095 ID#: 93PL3-018
Office: PL3
Contract #: FO4611-93-C-0091
PI: Clyde F. Parrish
Title: Treatment of Nitrate and Mixed Nitrite/Sulfate Contaminated Waste Water
Abstract: This Phase I proposal describes an innovative process to treat waste waters containing a high concentration of nitrates and mixed nitrite/sulfate, which would permit dumping to [illegible]ide and/or reuse. This waste water will be produced by a second stage nitrogen tetroxide vapor scrubber system to be used in series with current sodium hydroxide/water vapor scrubbers. This new Stage II system will use a blend of sodium hydroxide and sodium sulfite in water as the scrubbing liquors and produce waste waters containing high concentrations of nitrate and mixtures of nitrates and sulfates. Mainstream's treatment system should produce an effective economical process to treat these waste waters and produce sodium hydroxide for reuse in the system and provide a detoxified by-product that would be suitable for use as a liquid fertilizer. The Phase I effort describes the development of the required chemistry and processes for neutralizing and detoxifying the waste waters and preliminary design of the associated process hardware. The Phase II effort would consist of the design, fabrication, and demonstration testing of the pilot scale process developed in Phase I. The Phase III effort would demonstrate the process operation prototype, full scale hardware, interfaced with a selected on-site operation.

MAINSTREAM ENGINEERING CORP.
200 YELLOW PLACE
ROCKLEDGE, FL 32955
Phone: (407) 631-3550
Topic#: 93-166
Office: WL0
Contract #: F08630-93-C-0079
PI: Robert F. Scaringe
ID#: 93WL0-078
Title: Design and Demonstration of an AAIS Pod Cooling System
Abstract: The Air Force is developing a test capability to simulate wave forms, modes, and power levels of advanced threat airborne interceptors. The Advanced Airborne Interceptor Simulator (AAIS) will be a pod mounted simulator designed to achieve a high degree of autonomy. The technical challenges of pod mounted simulator includes pod cooling. This Mainstream Phase I proposal will quantify the cooling requirements and explore passive and active cooling methods to satisfy the requirements. This Phase I effort includes the design and optimization of a rugged, lightweight, AAIS pod cooling system. Experiments are proposed in Phase I to demonstrate the selected concept and to provide a sound basis for substantiating the Phase I performance projections. Phase II will result in the production of a prototype unit capable of being tested in an actual field environment. Data will be collected to verify performance capabilities and will be provided in a final evaluation report. A tremendous commercial potential exists, and Mainstream has already committed funds for a Phase III commercialization of the hardware.

MAN-MADE SYSTEMS CORP.
4020 ARJAY CIRCLE
ELLICOTT CITY, MD 21042
Phone: (301) 596-4915
Topic#: 93-023
Office: AL
Contract #: F41624-93-C-2005
PI: Richard L Horst, PhD
ID#: 93AL -226
Title: Telectrode Systems for Unobtrusive Biopotential Recording
Abstract: Biopotential recordings of human psychophysiological parameters are hampered in many field settings, and some laboratory and clinical settings, by the sensor technology. Conventional electrodes, which tether the subject to the signal amplification and recording equipment, are cumbersome to apply, often interfere with normal movements, are easily dislodged, and induce electrical noise due to movement of the electrode wires carrying low level signals. This project seeks to design essentially wireless electrode recording systems that use radio frequency telemetry to transmit the biopotential signal from the recording site to a body-worn transceiver and then to a remotely located receiver. The present subcontractor has developed transceiver and receiver technology that will be reviewed and customized as needed for the present application. The focus here will be on developing a generic design for the sensor subsystem ("telectrodes"), to include the transducer interface with the skin, miniaturized amplifier and filter circuitry, an optimal connection between the transducers providing differential inputs to the amplifier, a long-lasting but compact battery, and transmitter. Phase I will consist of a design specification, development of a bench-top engineering prototype, design trade-off studies using the prototype, and the delineation of a detailed design.

MARYLAND TECHNOLOGY CORP.
10210 SUNWAY TERRACE
ELLICOTT CITY, MD 21042
Phone: (410) 461-3158
Topic#: 93-106
Office: PL6
Contract #: F04704-93-C-0013
PI: James T. Lo
ID#: 93PL6-006
Title: Neural Filtering for INS and GPS Integration
Abstract: The neural filtering that has recently been developed at Maryland Technology Corporation is proposed to replace Kalman filtering in integrating INS and GPS. A neural filter is a recursive non-linear filter optimal for the given neural network architecture and approaches the least-squares filter as the number of neurons in the filter increases. All the three main formulations for the INS and GPS integration, namely the direct, indirect feed forward and indirect feedback using the neural filtering, will be studied, with the emphasis placed on the first, and compared to those using Kalman filtering.

MATERIALS & SYSTEMS RESEARCH, INC.
62 EAST - CLEVELAND AVENUE
SALT LAKE CITY, UT 84115
Phone: (801) 466-1262
Topic#: 93-004
Office: AEDC
Contract #: F40600-93-C-0008
PI: Dr. Jan-Fong Jue
ID#: 93AED-044
Title: Novel, Low Cost t'- and m'-Zirconia Ceramics for a Storage Heater
Abstract: The objective of this work is to determine the best possible polycrystalline zirconia from the standpoint of properties

5

and cost for applications in storage heaters. Our prior work has shown that highly stable tetragonal t'-zirconia with domain structure containing (< = 4 mol.% yttria) and monoclinic m'-zirconia containing no yttria exhibits properties superior to cubic zirconia > = 8 mol.% yttria. The excellent properties of t'- and m'-zirconia and stabilizers are the result of their domain structure. A survey of available zirconia and stabilizers will be conducted to identify suitable materials from the standpoint of cost. For the determination of optimum composition, samples with yttria content between 0 and 20 mol.% will be fabricated by heat treating at temperatures > = 2000 C. Creep resistance, erosion resistance, thermal shock resistance, strength, toughness, stability at low (200 to 600 C) and high (approx 1600 C) temperatures, and thermal conductivity of conventional tetragonal, highly stable t'-zirconia, shatter-proof m'-zirconia, and cubic zirconia will be measured. This information will be used to identify the most optimum yttria content and processing conditions of zirconia for storage heater applications. It is anticipated that t'-materials with yttria content < = 3 mol.% and m'-materials with no yttria will be the best materials, both from the standpoint of properties and cost.

MATERIALS TECHNOLOGIES CORP.
57 MARYANNE DRIVE
MONROE, CT 06468
Phone: (203) 874-3100

Topic#: 93-119
Office: WL3
Contract #: F33615-93-C-1252
PI: Dr. Frederick Wu

ID#: 93WL3-052

Title: Automated Defect Analysis of Material Surface Defects

Abstract: Analysis of material surface defect plays an important role in the development of new materials and fabrication processes, and in the diagnosis of process problems in material manufacture. The task of manual defect analysis is labor intensive and tedious, and the level of automation available is limited. We propose to develop image processing techniques and a complete system to fully automate defect analysis. Features that quantify size, shape, orientation, and distribution of defects will be selected according to user needs. Algorithms for efficient computation of these defect features will be developed. Capability for graphic data display will be incorporated.

MAXDEM, INC.
140 E ARROW HIGHWAY
SAN DIMAS, CA 91773
Phone: (909) 394-0644

Topic#: 93-124
Office: WL4
Contract #: F33615-93-C-3203
PI: Dr Mark S. Trimmer

ID#: 93WL4-041

Title: Advanced Thermoplastic Matrix Resins for Lightweight Structural Composites

Abstract: Maxdem has developed a novel family of exceptionally high modulus, high strength, thermoplastic resins, designated Poly-X, based on processable rigid-rod polymer technology. Poly-X derivatives possess a unique array of properties among organic polymers and, yet, are projected to be competitively priced at commercial production levels. Composites fabricated with Poly-X resins are expected to be lightweight, have unprecedented compressive strengths, have low flammability, be thermally and thermooxidatively stable, and to be resistant to corrosion and a wide variety of solvents and chemicals. During the proposed Phase I work, 2 kilograms of one Poly-X derivative, to be chosen after preliminary fiber-resin assessments, will be prepared for detailed resin testing, development of processing techniques, and composite panel fabrication and testing. A successful effort will demonstrate that high quality Poly-X composites can be prepared by standard thermoplastic composite fabrication techniques and will provide baseline mechanical and failure properties. Phase II efforts will build on this work and include more detailed testing of larger structural sections to optimize the various parameters (fiber-matrix interface, resin toughness, etc.) critical for achieving the ultimate promise of ultra-lightweight composites.

MDA ENGINEERING, INC.
500 EAST BORDER STREET
ARLINGTON, TX 76010
Phone: (817) 860-6660

Topic#: 93-164
Office: WL0
Contract #: F08630-93-C-0026
PI: Ralph Noack

ID#: 93WL0-043

Title: Interdisciplinary CFD: Coupled Aero/Structural Heating In A Parallel Computing Environment

Abstract: A coupled solution for the flow over a flight vehicle including the stress state of the vehicle structure, and the transient temperature distribution in the structure is proposed. Aerodynamic heating will be computed using a hybrid grid code designed for store separation. Structural heating may create special issues that must be included. If the structure is pinned or clamped, heating may induce high stress states. In addition, high structural temperatures may cause functional failure

of operational portion of the vehicle. If infrared sensors are employed, the shock layer temperatures around the vehicle and the structural temperature field may be sufficiently high that the sensors are adversely affected and may even be inoperative. In order to solve this interdisciplinary problem, it is proposed that the coupled fluid dynamic, structural, heat conduction code development be carried out by using a parallel environment on engineering workstations. Several parallel computing environments will be examined for efficiency and ease of use as well as the portability to large massively parallel systems. The final goal will be a coupled code to solve a class of interdisciplinary problems on either a parallel environment using workstations across a network or a massively parallel system.

MEMBRANE TECHNOLOGY & RESEARCH, INC.
1360 WILLOW ROAD, SUITE 103
MENLO PARK, CA 94025
Phone: (415) 328-2228
Topic#: 93-011 ID#: 93AFC-050
Office: AFCESA
Contract #: FO8635-93-C-0110
PI: J. G. WIJMANS
Title: VOC Removal From Air Force Waste-water Streams
Abstract: Many Air Force base operations produce wastewater streams containing dissolved volatile and nonvolatile organics, suspended solids, emulsified oils, and dissolved metal ions. Discharge of these streams, untreated, to the municipal sewer is increasingly unacceptable. Dissolved volatile organic compounds (VOCs) are the principal problem; their removal would usually make the water dischargeable. MTR is developing a technology that combines air stripping, to remove VOCs from water, with membrane vapor separation, to remove the VOCs from the resulting air stream. In this program, we propose to use a batch jet aeration unit controlled by a microprocessor for the air-stripping step. This unit will be more resistant to fouling by suspended solids and emulsified oils than the packed column aeration system used to date. Also, by adjusting the timing of the aeration cycle, the degree of VOC removal and the volume flow of the stream treated can be controlled. This is important in applications at Air Force bases, where the composition and flow of water to the unit may vary over a wide range. The overall technical feasibility of the approach will be tested in Phase I. A proof-of-concept pilot system will be built and demonstrated in Phase II.

MEMBRANE TECHNOLOGY & RESEARCH, INC.
1360 WILLOW ROAD, SUITE 103
MENLO PARK, CA 94025
Phone: (415) 328-2228
Topic#: 93-011 ID#: 93AFC-052
Office: AFCESA
Contract #: FO8635-93-C-0097
PI: J. G. WIJMANS
Title: Recovery of Hydrocarbon Vapors From Vent-gas Streams
Abstract: The Department of the Air Force uses large volumes of volatile organic compounds, principally hydrocarbon fuels. As much as 1% of these volatile liquids is lost in vent gases produced during transport, storage, and transfer operations, posing an economic and environmental problem to the DoD. This proposal describes the development of a membrane system to recover and recycle the organic vapors. The recovery system will both save resources and alleviate a serious environmental problem. In the Phase I program, the concept will be evaluated at the bench scale, by modifying an existing membrane vapor separation system. The technical and economic feasibility of the process will be analyzed using the data obtained with this system. In Phase II, a proof-of-concept system will be constructed and operated at one or more DoD sites.

MERIT TECHNOLOGY, INC.
5068 W. PLANOPARKWAY
PLANO, TX 75093
Phone: (214) 733-7091
Topic#: 93-071 ID#: 93PL1-917
Office: PL1
Contract #: F29601-93-C-0097
PI: Jay T. Labhart
Title: Reprogrammability of Space-based Expert System
Abstract: Progress in expert systems technology has made it possible to realize practical applications in a wide variety of space system tasks. Merit, utilizing software and expertise gained in previous SBIR initiatives, can produce a modular software component capable of reprogramming onboard expert systems executing with the constraints of the GVSC/1750A instruction set architecture. This document proposes to identify characteristics for employing and reprogramming these systems, identify the constraints for uplinking and downlinking of information, and design an approach for implementing this function with the existing Spacebased Expert System Development Environment (SEDE).

87

METABOLIX, INC.
P O BOX 695
CAMBRIDGE, MA 02142
Phone: (617) 253-6728
Topic#: 93-143 ID#: 93WL5-311
Office: WL5
Contract #: F33615-93-C-5351
PI: Simon F Williams
Title: Biodegradable Plastic Media Blast Materials
Abstract: Plastic media blasting (PMB) is a process used to rapidly remove coatings from almost any product. Current PMB materials, however, are not easy to dispose of once they have been used. The focus of this proposal is to identify new PMB materials that can meet the following requirements: compatibility with existing PMB materials; stripping rates competitive with state of the art PMB materials; and, complete biodegradability to carbon dioxide and water. Specifically, Metabolix plans to determine the feasibility of using polyhydroxyalkanoate (PHA) thermoplastics as PMB materials to meet these requirements. Metabolix's technology can be used to manufacture new and existing PHA thermoplastics at economical prices. These materials are totally biodegradable and may be ideal materials for PMB. The objectives will be to: prepare different formulations of PHA thermoplastics for blasting; and, determine the strip rates of these PHA materials in PMB. PMB is already used extensively by the US Air Force, Boeing and America West for the exterior stripping of aircraft. In addition, there are many other applications which include the dry stripping or cleaning of: marine vessels; machinery, engines and equipment; trucks and containers; injection molds; and, ground transportation vehicles and equipment.

METROLASER
18006 SKYPARK CIRCLE #108
IRVINE, CA 92714
Phone: (714) 553-0688
Topic#: 93-002 ID#: 93AED-024
Office: AEDC
Contract #: F40600-93-C-0004
PI: Cecil F. Hess, Ph.D.
Title: Nonintrusive Droplet Characterization System
Abstract: This proposal describes a program to develop a system to measure the spatial distribution of droplet size, liquid water content, and the droplet velocity in engine test cells. The twelve foot duct diameter rules out most light scattering and imaging techniques. The liquid water content of up to 5.6 g/m3 dictates that the probe volume must be no larger than about 10E8 micron3 resulting in a narrow waist with a limited Rayleigh range. To avoid the presence of potentially harmful objects in the inlet path, the proposed system must have a long range with the transmitter and the receiver remaining outside the specified 12 foot duct. The proposed system includes a laser sheet that can be focused to the required waist dimensions anywhere along the duct. The light scattered by droplets crossing the center of the focused sheet is collected by a receiver that tracks the waist position. Several schemes to locate the center of the laser sheet and avoid Gaussian ambiguity will be evaluated. Phase I will include analytical and experimental research that define optimum strategies that will be tested on a breadboard under controlled conditions.

METROLASER
18006 SKYPARK CIRCLE #108
IRVINE, CA 92714
Phone: (714) 553-0688
Topic#: 93-099 ID#: 93PL4-032
Office: PL4
Contract #: F19628-93-C-0063
PI: Peter A. DeBarber, Ph.D.
Title: Resonance Holographic Interferometric Spectroscopy for Ion Composition Detection if High Temperature Plasmas
Abstract: This is a proposal to research and develop a new diagnostic approach for measuring ion composition and density in high temperature high velocity plasmas. The method proposed is Resonance Holographic Interferometric Spectroscopy (RHIS) applied to plasmas produced in an arcjet torch. RHIS is a new diagnostic technique combining the three dimensional capabilities of holography, the phase sensitivity of interferometry, and the species selectivity of spectroscopy. An arcjet apparatus capable of generating readily variable plasma conditions with temperatures up to 4500K and gas velocities of up to Mach 4 will provide the Phase I testing environment. In addition to ion composition, the RHIS diagnostic has the potential to measure such parameters as temperature, pressure, velocity, density, mass flux, and electron density. This proposal outlines work to characterize the feasibility of RHIS as a new diagnostic for high temperature plasmas. Recommendations regarding the optimal instrument design and optimal data reduction schemes will be made as a pathway into a Phase II program.

METROLASER
18006 SKYPARK CIRCLE #108
IRVINE, CA 92714
Phone: (714) 553-0688

Topic#: 93-105
Office: PL6
Contract #: F04704-93-C-0010
PI: Peter DeBarber

ID#: 93PL6-036

Title: Novel Diagnostic Approach to Reentry Plasma Boundary Layer Simulations

Abstract: This is a proposal to research and develop a new diagnostic approach for studying reentry plasma boundary layers. The method proposed is Resonance Holographic Interferometric Spectroscopy (RHIS) applied to boundary layer plasmas simulated in an arcjet apparatus. RHIS is a new diagnostic combining the three dimensional capabilities of holography, the phase sensitivity of interferometry, and the species selectivity of spectroscopy. An arcjet apparatus capable of generating boundary plasma conditions with temperatures up to 4500K and gas velocities of up to Mach 4 will provide the Phase I testing environment. The apparatus is simple to construct and operate, and is easily configured to a wide range of reentry plasma conditions. The RHIS diagnostic has the potential to measure such parameters as temperature, pressure velocity, density, mass flux, and electron density. This proposal outlines work to characterize RHIS as applied to reentry plasma simulations, to determine the feasibility of extrapolating and integrating the method to large-scale tests, and to make recommendations regarding the optimal instrument design and optimal data reduction schemes.

MICRACOR, INC.
43 NAGOG PARK
ACTON, MA 01720
Phone: (508) 263-1080

Topic#: 93-182
Office: WL0
Contract #: F08630-93-C-0050
PI: James A. Keszenheimer

ID#: 93WL0-241

Title: Wide Field of View Scanned Laser Radar System with No Moving Parts

Abstract: Laser radars which use mechanical systems to scan the beams have several limitations. In addition to the size, weight and power budgets necessary to incorporate and operate them, there are the issues of reliability, maintenance and survivability. Flexibility to vary the scanned field of view and to concentrate on individual items of interest is extremely desirable. An electronically scanned laser that has no moving parts overcomes all the above shortcomings. A linear array of addressable microchip lasers directed through a divergent lens system is proposed. The microchip lasers will be sequentially addressable, lens system is and operated in a Q-switched mode. When combined with either single-element or CCD-array detectors, a compact, low-power, high-resolution laser radar can be achieved, which is effective for such applications as: battlefield target acquisition, classification and tracking, high resolution remote sensing and terrain profiling.

MICROCOSM, INC.
2601 AIRPORT DR., SUITE 230
TORRANCE, CA 90505
Phone: (310) 539-9444

Topic#: 93-086
Office: PL1
Contract #: F29601-93-C-0106
PI: EDWARD L. KEITH

ID#: 93PL6-001

Title: Low Cost Launch System

Abstract: Microcosm proposes to undertake technical evaluation of a launch vehicle concept capable of reducing near-term launch costs by a factor of 10. Phase I will determine the government requirements which can be met by the proposed vehicle and conduct a formal review of a specific point design and the methods employed to hold down cost. Phase I will result in an overall requirements definition, a point design to meet those requirements at dramatically lower than traditional costs, a technology demonstration plan, and the results of a formal review of these elements. Phase II will begin with a technology demonstration (building and firing tanks and engine) to show that the proposed methods can result in dramatic cost savings, even during the development cycle. It will also address specific technical issues such as control system response times, fabrication and assembly techniques, and issues raised during the Phase I review. By the end of the Phase II the government will have a demonstration of the key cost saving technologies, identification and assessment of the principal technical, cost, and management issues involved, and a specific plan for developing a new launcher for approximately the cost of procuring a single vehicle using more traditional approaches.

MICROCOSM, INC.
2601 AIRPORT DR., SUITE 230
TORRANCE, CA 90505

Topic#: 93-089
Office: PL1
Contract #: F29601-93-C-0100

ID#: 93PL1-116

Phone: (310) 539-9444 PI: DR. JAMES R. WERTZ
Title: Satellite Tool Kit - Mission Utility and Systems Engineering Module (STK/MUSE)
Abstract: Microcosm and Analytical Graphics propose to extend the existing commercial Satellite Tool Kit (STK) mission analysis system to incorporate sensor simulation and mission utility. The result will be the first general purpose, commercially available, space mission utility simulator. It will run on available workstations and will allow the user to quantify mission performance as a function of system design, scenarios, and environmental parameters. The user will be able to rapidly estimate under what conditions and how well overall mission objectives can be met or whether a less complex and expensive design could do the job as well. It will support multiple missions without additional coding. Customized analysis needs can be met by "plug-in" user-developed modules, connection with existing simulations through the standard interface or via data files generated by an external program. Phase I will provide detailed system definition and requirements and will include rapid-prototyping of a module to evaluate two mission utility figures of merit -- response time (applied to the FAS mission) and station keeping accuracy (applied to autonomous orbit maintenance). This will allow the government to evaluate specific features and requirements to be incorporated in the Phase II development.

MICROPUMP CORP. Topic#: 93-012 ID#: 93AFC-186
BOX 8975 Office: AFCESA
VANCOUVER, WA 98668 Contract #: FO8635-93-C-0114
Phone: (206) 253-2008 PI: BONNIE LAMBERT
Title: Portable Refrigerant Recycle and Recovery Unit
Abstract: Studies have shown that halocarbon refrigerants (CFCs and HCFCs) damage the earth's ozone layer. To halt the damage, regulations (i.e., U.S. Clean Air Act of 1990) were created that prohibit emission of these refrigerants into the atmosphere. These regulations have created a need for refrigerant recovery and recycle systems. However, units available today are limited in their capabilities. Most are unable or ill-suited to cope with refrigerants of unknown or different phases. They can also be: slow and complicated to use, heavy, expensive, and unable to meet recent EPA regulations regarding recovery unit vacuum pressures. Micropump Corporation and Eco-Dyne Systems, Inc. propose to develop a portable refrigerant recycle and recovery unit. The proposed unit will be modular, light-weight, cost-effective, easy to use, and able to meet EPA, ARI, and UL specifications for recycle and recovery units. The innovative component of the unit will be the dual-phase pump. The direct drive vane pump/brushless DC motor combination will recover a variety of refrigerants regardless of phase (liquid or vapor) under a wide range of ambient conditions.

MIKOS LTD. Topic#: 93-037 ID#: 93ES2-151
2214 ROCK HILL RD., CIT TOWER, SUITE 300 Office: ES2
HERNDON, VA 22070 Contract #: F19628-93-C-0143
Phone: (703) 481-3620 PI: Dr. Francine Prokoski
Title: Innovative Approaches in Physical Security Systems [Personnel Identification Via Facial Thermography]
Abstract: MIKOS has developed proprietary techniques for identification of persons by means of facial thermography. A facial thermogram is a high-resolution temperature map of the face surface. It is obtained by use of a camera which is sensitive to infrared emissions rather than to visible light. The face contains anatomical features which are unique to the individual, which produce characteristic patterns referred to as "elemental shapes" in the thermogram. The characteristic patterns differ extensively from individual to individual; even identical twins have different thermograms. This biometric technique, patented by MIKOS, offers a totally passive, non-contact, identification at a distance capability. The proposed study will evaluate the performance of analytical techniques developed by MIKOS in identifying individuals, and quantity Type I and Type II error rates. The project will lead to the production of a capability of recognizing persons under all lighting and shadow conditions, including total darkness. In conjunction with recent advances in thermal camera technology, this study will lead to commercialization of a low cost biometric technique superior to existing methods.

MILLITECH CORP. Topic#: 93-164 ID#: 93WL0-028
SOUTH DEERFIELD RESEARCH PARK Office: WL0
SOUTH DEERFIELD, MA 01373 Contract #: F08630-93-C-0028
Phone: (413) 665-8551 PI: Dr. H.I. Ewen

Title: Analytical Model of the Passive Millimeter Wave Scenario
Abstract: A common requirement of missile delivery systems is an ECM resistant, all-weather, day/night capability. The all-weather, day/night requirement leads to millimeter waves as a reasonable solution. The current proliferation of ARM devices favors passive rather than active modes. An analytical model of the passive scenario predicts that atmospheric attenuation is not an important consideration, and essentially equivalent performance can be obtained over the entire spectrum from 30 to 140 GHz. The operational availability of the full millimeter wave spectrum for radiometric solutions to tactical weapon sensor requirements, represents a new dimension of opportunity. Other equally important sensor system implications are predicted by the Analytical Model. Many have a direct bearing on capabilities of interest to the Air Force Armament Directorate, Eglin AFB. Verification of Model predictions is an important first step. The Phase I work plan addresses both the requirements and methods for verification by direct measurement. Active participation by the research staff of the Armament Directorate, Eglin AFB is needed in order to realize the full potential of this effort, by focusing the direction of this investigation on Air Force missions and their future tactical weapon sensor requirements.

MIMS TECHNOLOGY DEVELOPMENT COMPANY
1291 CUMBERLAND AVENUE, SUITE E
WEST LAFAYETTE, IN 47906
Phone: (317) 497-4857

Topic#: 93-011 ID#: 93AFC-111
Office: AFCESA
Contract #: FO8635-93-C-0086
PI: SCOTT BAUER

Title: Analysis of Extractable Organic Compounds in Water by Two Stage Membrane Introduction Mass Spectrometry
Abstract: The proposed effort will investigate the effectiveness of using a dual stage membrane probe coupled to a Finnigan Magnum Ion Trap mass spectrometer for the direct analysis of extractable organic compounds in water. The proposed system will be able to detect trace levels of organic compounds in water in less than five minutes with no sample pre-treatment or extraction of the analytes from the water matrix. The proposed instrument is an innovative modification of membrane introduction mass spectrometry systems that have recently proved successful in the analysis of volatile organics directly from water in the part per trillion range. Three membrane pairs will be investigated for their performance in the proposed system. A complex solution containing environmentally significant organic compounds including PAH's, PCB's, and pesticides, amines, and volatile organics in water will be analyzed by the proposed membrane systems. The experiments will provide the groundwork for future studies that will ultimately result in the design and construction of a commercial instrument geared toward environmental analysis in fixed site laboratories, mobile test units, and industrial process monitors.

MISSION RESEARCH CORP.
POST OFFICE DRAWER 719
SANTA BARBARA, CA 93102
Phone: (513) 429-9261

Topic#: 93-158 ID#: 93XRX-114
Office: XRX
Contract #: F33615-93-C-1328
PI: Dr Robert J. Puskar

Title: Flare Plume RCS Enhancement for Multi-spectral Decoy Applications
Abstract: Interest in the use of expendables as a passive ECM for aircraft self-protection has increased dramatically in the past few years. One of the important remaining problems is that of obtaining or producing multi-spectral signatures for the expendables or decoys. Currently, separate expendable devices are needed if the threat sensor type is unknown or multi-spectral. A few recent Air Force programs have pursued the idea of obtaining RF, IR and laser (EO) signatures from a single decoy, but the technology is still in the developmental state, and some of the concepts result in a mechanically complex device. The approach proposed here is different in that exiting flare technology will be used as the baseline or starting point, and the RF signature will be obtained by modifying the flare materials that generate or enhance the RF scattering of a measurable (but small) RCS generated by conventional flares. Other experimental work has shown that seeding the flare material with compounds such as Cesium will increase the concentration of free electrons in the flare plume, which can result in increased RCS levels.

MISSION RESEARCH CORP.
735 STATE ST., P.O. DRAWER 719
SANTA BARBARA, CA 93102
Phone: (505) 662-0070

Topic#: 93-162 ID#: 93XRX-210
Office: XRX
Contract #: F33657-93-C-2330
PI: Mr. Barry G. Charles

Title: Aerial Refueling Communication Using Solar Blind Ultraviolet Radiation
Abstract: Mission Research Corporation (MRC) proposes to analyze and develop and aerial refueling communication system

(93)

that uses Solar Blind Ultraviolet (SBUV) radiation, from 220 to 280 nm, as the communication carrier. The advantage of SBUV is that the propagated links can be both non-line-of-sight (NLOS) and have a very low probability of interception and detection (LPI/LPD). Minimum terrestrial background radiation in the SBUV band enables the communication links to be operated at very low power levels day or night. Communication between aircraft during aerial refueling missions is currently limited to sub-desirable techniques when radio silence conditions are required. SBUV communication techniques can greatly improve both the safety and operational capabilities during critical air-to-air refueling missions by providing both voice and data communications channels between the aircraft involved.

MOLECULAR TECHNOLOGIES, INC.
145 MOORE STREET
LOWELL, MA 01852
Phone: (508) 458-8915
Topic#: 93-016 ID#: 93AFO-064
Office: AFOSR
Contract #: FQ8671-9301308
PI: Mr Sandip Sengupta
Title: Organosilicon Polymeric Non-linear Optical Materials for Optical Switching and Modulation
Abstract: There is a need for non-linear optical materials which can be used in optical devices that operate in severe military environments. Most of the new organic material based optical materials that are poised to replace traditional inorganic materials in this area, due to their improved optical properties and ease of fabrication, are particularly deficient in the are of environmental stability, especially temporal stability of the non-linear optical properties at higher temperatures. We propose to demonstrate new organosilicon systems with useful non-linear optical properties. These materials will be fabricated into thin films and their optical properties will be studied. Preliminary studies of temporal stability, particularly at higher temperatures will also be made. The Phase II effort will seek to optimize these characteristics as well as overall optical and mechanical properties.

MORGAN RESEARCH CORP.
2707 ARTIE STREET, SUITE 17
HUNTSVILLE, AL 35805
Phone: (205) 533-3233
Topic#: 93-012 ID#: 93AFC-177
Office: AFCESA
Contract #: FO8635-93-C-0117
PI: WILLIAM D. ENGELKE
Title: CFC Cryorecovery System
Abstract: The Clean Air Act of 1990, Section 608 mandates the recovery of Clorofluorocarbons (CFCs) from air conditioners, refrigerators, and heat pumps prior to maintenance or disposal of these devices to prevent further damage to the earth's ozone layer. This project proposes an innovative design for a ruggedized system that would recover CFCs and related compounds by a high-volume cryo-pumping technique. The proposed system offers increased safety over conventional compressor-based systems as no high pressures are produced regardless of system gas content.

MSNW, INC.
P.O. BOX 865
SAN MARCOS, CA 92079
Phone: (215) 940-0601
Topic#: 93-015 ID#: 93AFO-012
Office: AFOSR
Contract #: FQ8671-9301352
PI: Dr Brian J. Sullivan
Title: Structural Integrity of Intelligent Materials and Structures
Abstract: Shape memory alloys (SMA's) have been a major element of the intelligent materials and structures research effort, and actuators for the control of structures have been designed on the basis of their unique thermomechanical behavior. The design of SMA force and displacement actuators requires a fundamental knowledge of the behavior of these materials. There has been an extensive body of work focused on the development of constitutive models describing the thermomechanical response characteristics of SMA materials in monolithic form. Many applications, however, call for the embedding of SMA materials within structural components to sense and/or control the mechanical response of the structures. Very little work has addressed the mechanics of the interactions between the SMA elements and the host materials they are embedded within. Consequently, a micromechanical approach to understanding the thermomechanical interactions between the embedded SMA and the host material is required and will be the focus of this work. The project will be performed with the technical assistance of Virginia Polytechnic Institute (Dr Craig Rogers).

MSNW, INC.
P.O. BOX 865
SAN MARCOS, CA 92079
Phone: (215) 940-0601

Topic#: 93-068 ID#: 93PL1-028
Office: PL1
Contract #: F29601-93-C-0090
PI: DR. BRIAN J. SULLIVAN

Title: Carbon-carbon Joining Technology for Space Structure Thermal Management

Abstract: The work proposed here addresses key challenges to the development of brazed carbon-carbon joints for space structure thermal management applications. Interlayer materials are sought which will minimize thermal resistance across brazed joints, maintain good shear strength characteristics, have low residual stress states, and be applicable to the joining of very thin carbon-carbon panel components currently proposed for radiators and heat transfer devices. Proposed tasks include a systems survey to define near-term candidate commercial applications and their joining requirements, selection of appropriate interlayer materials for specific applications, prediction of multiphase microstructure which may form in interlayer materials after the joining operation, properties and performance characteristics of the product joints through mathematical modeling, and fabrication and testing of promising brazed joint concepts. The project will be performed with the engineering and technical assistance of Hughes Space and Communications Group and Wright State University.

MTL SYSTEMS, INC.
3481 DAYTON-XENIA ROAD
DAYTON, OH 45432
Phone: (513) 426-3111

Topic#: 93-051 ID#: 93ES3-107
Office: ES3
Contract #: F30602-93-C-0141
PI: David P. Geis

Title: Waveform and Vector Exchange Specification (WAVES) & VHSIC Hardware Description Language (VHDL) Modeling Guidelines

Abstract: MTL Systems, Inc. (MTL) and the University of Cincinnati (UC) propose to perform the Phase I development of WAVES/VHDL modeling guidelines. Our approach is to formulate initial guidelines, develop and test a set of small-to-medium WAVES/VHDL examples, test the set, and derive confirmed guidelines from the results of this testing. We are able to propose this Phase I example testing due to (1) an existing WAVES/VHDL design environment and (2) a set of examples by which to test the guidelines we develop. Specifically, our objectives are to (1) develop the example set, (2) use the example testing to demonstrate the utility of WAVES/VHDL guidelines and usage practices, and (3) recommend and distribute the guidelines and usage practices. The marriage of WAVES and VHDL in this effective design and test paradigm will be a significant enhancement to design practices across the industry. We will encourage use of, and obtain feedback upon, the guidelines through an organized contact, distribution, and follow-up program with industrial and government users. This will cultivate an acceptance of the guidelines even as they are being formulated, which will continue into the Phase II effort. The products of the Phase I effort, guidelines, demonstrated performance and industry acceptance/contacts, will form a solid foundation for Phase II.

MTL SYSTEMS, INC.
3481 DAYTON-XENIA ROAD
DAYTON, OH 45432
Phone: (513) 426-3111

Topic#: 93-111 ID#: 93WL2-056
Office: WL2
Contract #: F33615-93C-1235
PI: David Geis

Title: Reconfigurable, Real-time Radar Warning Receiver (RWR)

Abstract: MTL Systems, Inc. (MTL) and Calspan Corporation propose to develop and qualify the preliminary design of a Reconfigurable, Real-time Radar Warning Receiver (RWR) simulation. The development will take advantage of existing development platforms and performance modeling tools to develop and demonstrate critical aspects of the design in Phase I. The first objective is to design the RWR simulation software. The J-MASS tool will be employed to design the necessary modularity and reconfigurability and to demonstrate the design concepts. The second objective is to design the real-time computing system. Existing and proven computing system performance modeling tools and techniques will be used to design and demonstrate the real-time computing system design. The third objective is to design the overall RWR system and the fourth is to design the interfaces into a host facility. These will be accomplished through standard and tested system engineering and integration modules and designs. Through the demonstrations of modularity, reconfigurability and execution speed performance, the design will be established as both feasible and ready for direct transition into a Phase II simulator development program.

95

NANOTRONICS, INC.
C/O ENTERPRISE PARTNERS, 1205 PROSPECT ST. SUITE 5
LA JOLLA, CA 92037
Phone: (619) 793-2661
Topic#: 93-049 ID#: 93ES3-087
Office: ES3
Contract #: F30602-93-C-0151
PI: Dr. Michael J. Heller
Title: Multi-wavelength DNA Optical Storage Media
Abstract: In recent years, secondary storage has become a bottleneck in portable computing and electronics for government, industry, and consumers. Enhancements in storage will continue to lag microprocessor advances for years to come. Nanotronics, Inc. has initiated a research effort that promises to change the paradigm in mass storage, thereby enabling up to 100 times improvement in planar surface storage capacity with concurrent increases in data transfer rate. Nanotronics has developed enhanced deoxyribonucleic acid (DNA) polymers that will absorb excitation light energy at a single wavelength and re-emit predetermined multiple wavelengths, all occurring at ambient temperatures. By emitting spectra rather than binary on/off bits, the data word size is increased significantly and parallel access is enabled. Data will be stored in the molecular structure of synthetic DNA, bringing true nanotechnology to science and industry. The diffraction limit of current optical storage systems will be circumvented because data bits per unit area will increase with the number of distinguishable pre-programmed wavelengths. Thus wavelength is the third dimension for this optical data storage scheme. Furthermore, a four-dimensional secondary storage scheme may be possible by adding a third spatial dimension that would further multiply the storage density.

NEURODYNE, INC.
1 KENDALL SQUARE, BUILDING 200
CAMBRIDGE, MA 02139
Phone: (617) 252-3360
Topic#: 93-069 ID#: 93PL1-271
Office: PL1
Contract #: F29601-93-C-0094
PI: Theresa W. Long
Title: Autonomous Neural Control of Space Platforms
Abstract: The autonomous control of flexible space structures will require a distributed computational architecture that provides the ability to perform system identification and adaptive control after orbital deployment. Neural network based supervised learning algorithms and hardware provide a beneficial tool for reducing the need for a priori knowledge of the structures behavior through rapid system identification and health monitoring on-line. Furthermore, the combined use of neural networks and optimal control presents a stochastic non-linear learning control architecture that provides the ability to rapidly adapt on-line to uncertainty in the structure's behavior. Under an existing program from McDonnell Douglas Aerospace, NeuroDyne is applying internally developed decentralized learning optimal control tools to active vibrational damping of "smart" composite aircraft structures. In Phase I, our team will leverage this research to further develop and apply real-time system identification and learning optimal control for control/structural interaction (CSI) of the Phillips Laboratory Planar Articulating Controls Experiment (PACE) test bed. Final goal of this effort will be integration of controls and demonstration of vibration damping and precision pointing for the PACE structure.

NEURODYNE, INC.
1 KENDALL SQUARE, BUILDING 200
CAMBRIDGE, MA 02139
Phone: (617) 252-3360
Topic#: 93-154 ID#: 93WL6-172
Office: WL6
Contract #: F33615-93-C-2315
PI: DAVID L. ELLIOTT
Title: Neural Network Technology for Jet Engines
Abstract: Integrated flight and propulsion control systems will be necessary to satisfy critical mission requirements in future aircraft. Aircraft flight and propulsion control systems are traditionally designed to operate independently of each other. This method often results in a system where performance is compromised for robustness and operability. There exists a great need for non-linear system identification and control approaches that can optimize on-board models for off-nominal behavior such as engine deterioration and engine-to-engine variations. NeuroDyne will team with Scientific Systems in the development of a non-linear adaptive engine diagnostics and control method using a combination of neural network based system identification and optimal control for aircraft engines. This program will leverage an existing program funded by NASA Lewis and Dryden Research Centers which involves NeuroDyne and McDonnell Douglas in the development of a neural network based estimation component for engine efficiencies and diagnostics in the Performance Seeking Control (PSC) system. Our proposal will extend these results to develop a non-linear system identification and optimal control component for the Pratt and Whitney 1128 engine operating in a F-15 aircraft.

NIAGARA TECHNOLOGY LABORATORIES
4242 RIDGE LEA RD., SUITE 10
AMHERST, NY 14226
Phone: (716) 832-6269
Topic#: 93-037 ID#: 93ES2-035
Office: ES2
Contract #: F19628-93-C-0169
PI: Dr. John K. Schneider
Title: Exploratory Development of a New Subdermal Biometric Using High Resolution Ultrasonic Imaging
Abstract: As the technical director for Niagara Technology Laboratories, Dr. Schneider's 5 years research experience in the development of new biometrics using ultrasound, combined with Dr. Glenn's 40 years of expertise in imaging systems and Mr. Moore's 25 years National Bureau of Standards biometric research knowledge, provides the basis for the proposed innovative concept which utilizes high frequency ultrasound to obtain a subdermal image of the finger in an attempt to develop an entirely new biometric with extremely high accuracy rates. The objective of Phase I will be to develop a preliminary subdermal ultrasound scanner and capture several images for evaluation. A few of the features and corresponding benefits of using ultrasound to perform subdermal imaging are summarized below. FEATURE BENEFITS: High frequency ultrasound; Able to penetrate beyond the surface of the body providing subdermal images; Signal easily processed with readily available (low cost) IC's Range gating; Able to image past the surface at selected depths making it superior to other subdermal approaches; Uses the tip of the finger; Lends itself to a very small, low cost device; Images subdermal artifacts; Not subject to the everyday erosion of features as in the case of the finger-print; Highly resistant to forgery due to the inability to identify and reproduce the structures.

NIELSEN ENGINEERING & RESEARCH, INC.
510 CLYDE AVENUE
MOUNTAIN VIEW, CA 94043
Phone: (415) 968-9457
Topic#: 93-100 ID#: 93PL4-038
Office: PL4
Contract #: F19628-93-C-0079
PI: Dr Steven C. Caruso
Title: Numerical Weather Prediction Via Massively Parallel Computing
Abstract: This proposal is concerned with the use of massively parallel computers for performing mesoscale numerical weather predictions (NWP). For the Phase I effort, a simple, but realistic model weather problem will be implemented on a parallel computer. The goal of the proposed research is to demonstrate the feasibility of using massively parallel processing techniques to gain significant computational efficiencies for typical calculations performed in mesoscale numerical weather prediction models. If the Phase I research is successful, a complete, operational mesoscale weather model will be ported to a parallel computer in a Phase II effort. The increased computational performance using parallel processing should permit the use of NWP codes in tactical operational environments, where CRAY-class supercomputers are not available. Greater computational efficiency may also permit the use of increased grid resolution in NWP models, thereby increasing their overall prediction accuracy and reducing the reliance on parameterized quantities.

NIELSEN ENGINEERING & RESEARCH, INC.
510 CLYDE AVENUE
MOUNTAIN VIEW, CA 94043
Phone: (415) 968-9457
Topic#: 93-164 ID#: 93WL0-009
Office: WL0
Contract #: F08630-93-C-0027
PI: Daniel J. Lesieutre
Title: Optimal Aerodynamic Design of Missile Fins with Geometric Constraints
Abstract: Within DoD there is a current need for the design or redesign of aircraft-borne weapon airframes to meet conformal/internal carriage requirements. A major constraint imposed by conformal/internal carriage is a limitation on the maximum stowable fin span of a weapon. Current aircraft such as the F-117 and future aircraft such as the F-22 are designed with internal carriage capability, but current weapons systems such as the Sidewinder and AMRAAM require modifications to meet these carriage requirements. Design or re-design of weapon airframes requires an extensive expenditure of labor and funds. Missile engineers can not simply reduce the span of missile fins without incurring potentially detrimental changes in the aerodynamic characteristics of the vehicle. Nielsen Engineering & Research (NEAR) proposes to develop an innovative design tool employing combined numerical optimization/aerodynamic prediction techniques for the optimal aerodynamic design of missile fins with geometric constraints such as those imposed by conformal/internal carriage and constraints set by actuator torque limits. This advanced optimization-based design tool will reduce the development time and costs associated with missile fin design or redesign.

NIGHT VISION CORP.
8145 RIVER DRIVE, SUITE 101
MORTON GROVE, IL 60053
Phone: (708) 966-8882
Topic#: 93-027 ID#: 93AL -122
Office: AL
Contract #: F41624-93-C-6004
PI: Danny Filipovich
Title: Liquid Crystal Displays within Image Intensifier Systems
Abstract: The ability to display critical information within the optical train of a night vision device has become a requirement in the aviation community. The current display approaches rely on CRT's, optical combiners, lenses, and fiber optic cable to inject the symbology within the optical train of the night vision device. Besides decreased image tube life, bulkiness, and additional weight, the performance and safety of such systems is considered marginal. Night Vision Corporation (NVC) has developed a unique approach to incorporate symbology within the optical train of a night vision device with much greater potential. We are proposing the insertion of a transparent LCD at the output side of the tube which can provide a multi-color display. This approach also allows for a relatively simple image fusion of intensified and HUD projected scenes. NVC proposes to conduct a complete survey of current technology to develop system requirements and then build and deliver a prototype of the approach within a ANVIS Night Vision Goggle Monocular.

NOISE COM, INC.
E. 49 MIDLAND AVENUE
PARAMUS, NJ 07652
Phone: (201) 261-8797
Topic#: 93-046 ID#: 93ES3-063
Office: ES3
Contract #: F19628-93-C-0086
PI: BENT HESSEN-SCHMIDT
Title: Broadband 60 GHz Coaxial Noise Sources
Abstract: The Phase I objective is to develop a 10 MHz to 65 GHz (or minimum 2 GHz to 60 GHz) coaxial noise source with a low VSWR. The noise source will use a millimeter-wave noise diode developed in 1992 (as a result of contract DAALO1-89-C-O9I6) and utilize 1-85 mm connectors. It will consist of a broadband impedance-matching section, circuitry containing the diode and DC blocking capacitors, and a temperature compensating current regulator. By using a technique, which separates the noise source into 3 sections (impedance-matching, DC blocking, and bias), attention can be paid to these basic elements of 60 GHz coaxial components. Noise sources are special by being very broadband of nature and are required to have a low VSWR in both on and off conditions. The broadband impedance-matching shall provide a constant spectral density of noise at the output, while maintaining the low VSWR as the noise diode is switched on and off, thus matching the package loss and diode impedance in these two states. It is a challenge to simultaneously obtain effective DC blocking/AC coupling at very low and very high frequencies. Successful completion of Phase I will therefore ensure useful results for development of other 60 GHz components or 110 GHz noise sources.

NOVA ENGINEERING, INC.
4747 DEVITT DRIVE
CINCINNATI, OH 45246
Phone: (513) 860-3456
Topic#: 93-037 ID#: 93ES2-055
Office: ES2
Contract #: F19628-93-C-0153
PI: Terrance J. Hill
Title: Robust Relocatable Physical Security System
Abstract: Two essential elements of any physical security system are the security sensors themselves and the communications network which interconnects them. Highly sophisticated biometric sensors which provide rapid, accurate personnel identification are currently available from several vendors and it is Nova Engineering's opinion that further development in this area does not represent the best value to the government at this time. Far more significant shortcomings exist in the area of the communications subsystem, particularly for security systems which must be frequently relocated. Wired interconnects are secure and jam resistant but are extremely labor intensive to install; this is impractical for relocatable systems. Wireless links, on the other hand, are very easy to install but existing reasonably priced receivers are easily spoofed or jammed, even unintentionally. Robust anti-jam MIL-spec transceivers, such as SINCGARS and HAVE QUICK are available, but their size, weight power consumption, and cost are all very high. This proposal describes Nova Engineering's innovative approach to mitigating these deficiencies. By combining current state-of-the-art biometric sensors with our unique Sinusoid-Free Spread Spectrum modulation, we are able to provide a low cost, high performance approach to Robust Relocatable Physical Security Systems.

NUCLEAR METALS, INC.
2229 MAIN STREET
CONCORD, MA 01742
Phone: (083) 695-4102
Topic#: 93-164 ID#: 93WL0-023
Office: WL0
Contract #: F08630-93-C-0056
PI: Mark J. Walz
Title: Heavy Metal Hard Target Penetrator
Abstract: The V.S. Air Force has a continuing need to develop improved penetrating bombs for the defeat of hardened command and communication bunkers. These reinforced concrete bunkers are quite often constructed below ground level and are formidable structures to defeat. Nuclear Metals, Inc. proposes a four month effort to design a depleted uranium (DU) version of the BLU-IO9/B, 2000 pound bomb. Hydrocode analyses of concrete penetration and the response of the explosive filled bomb case to penetration forces will be conducted. Iterative design and trade-off analyses are proposed beginning with the evaluation of two DU alloys: DU-.75% Ti and DU-2% Mo. Working within the current maximum weight of the BLU-IO9/B case, 1321 pounds, NMI will examine reduced diameter and increased length/diameter ratios for the bomb case. These designs will provide an increase in the depth of penetration while avoiding excessive internal pressures that would otherwise cause premature bomb detonation. An optimum design will be provided at the conclusion of Phase I along with a final technical report detailing major technical findings from the analyses. The preliminary bomb design will be suitable for fabrication of inert prototypes for test and evaluation in Phase II.

NZ APPLIED TECHNOLOGIES
12 WHITNEY AVENUE
CAMBRIDGE, MA 02139
Phone: (617) 497-0314
Topic#: 93-018 ID#: 93AFO-074
Office: AFOSR
Contract #: FQ8671-9301319
PI: Dr Peter E Norris
Title: Novel Method for Growth of p/n Type Expitaxial GaN for High Temperature Electronic Device Applications
Abstract: With the development of the first II/Vi (ZnS/ZnSe) blue lasers, wide bandgap materials have reached a new level of technological importance. For a long time, device development was hindered by inadequate materials technology. However, the epitaxial growth technologies originally used for GaAs/A1GaAs materials, such as MOCVD and MBE, have now matured. Their application to the case of wide bandgap semi-conductors promises solutions to many of the decades old problems. Historically, it has been impossible to produce wide gap III/V or II/VI materials with significant p-type conductivity. The proposed program utilizes a unique approach, utilizing Plasma Enhanced Chemical Vapor Deposition, to enhance the dopant incorporation efficiency of p-type impurities. This will allow the fabrication of blue LEDs with increased output using an approach which is better suited to mass production than the Low-Energy Electron Beam Irradiation method pioneered in Japan.

NZ APPLIED TECHNOLOGIES
12 WHITNEY AVENUE
CAMBRIDGE, MA 02139
Phone: (617) 497-0314
Topic#: 93-043 ID#: 93ES3-028
Office: ES3
Contract #: F19628-93-C-0078
PI: Jing Zhao
Title: Thin Film Holographic Materials and Devices by CVD Process
Abstract: Hologram in photorefractive media holds promise for a variety of future optical information processing applications. Currently, no materials and processing technology simultaneously meet all the requirements for practical holographic device applications. It seems advantageous to selectively optimize the promising materials for particular applications. We propose to synthesize high performance photorefractive films of BaTi03, LiNb03, and GaAs by an innovative plasma-enhanced metalorganic chemical vapor deposition (PE-MOCVD) process, with the emphasis on BaTi03 in Phase I. The three material systems are chosen because they have the highest figures of merit (diffraction efficiency, long storage time, and sensitivity, respectively) for different holographic applications. Effective processing technologies will also be developed to substantially improve the weakness of each materials, e.g. increasing the sensitivity of the ferroelectrics by methods of transition-metal doping and chemical reduction; increasing the diffraction efficiency of semi-conductor through the growth of quantum well structures. PE-MOCVD is ideal for holographic device fabrication due to its high growth rate, large-area, and low temperature processing capabilities. Moreover, the PE-MOCVD offers the potential for monolithic or hybrid-processing compatibility with OEIC device technology. Phase I addresses the heteroepitaxial growth of optical quality BaTiO3 films for holographic applications.

NZ APPLIED TECHNOLOGIES
12 WHITNEY AVENUE
CAMBRIDGE, MA 02139
Phone: (617) 497-0314

Topic#: 93-142
Office: WL5
Contract #: F33615-93-C-5339
PI: Jing Zhao

ID#: 93WL5-298

Title: Novel High Tc Superconducting Junction by Plasma-enhanced Chemical Vapor Deposition

Abstract: The availability of high-quality HTSC junction has direct implications in the development of quantum IR detectors and other electronic and optoelectronic applications. A novel piezoelectric BaTiO3/superconducting YBCO/bicrystal SrTiO3 grain boundary junction is proposed to be demonstrated in this program. This hybrid junction structure in which the tunneling space between the two grains can be tuned to achieve the optima performance via stress induced by a piezoelectric layer, potentially offers a viable scheme to high performance SIS junction. Currently, an advanced materials processing technology capable of controlling the mircrostructures of HTSC thin films is desirable for both scientific evaluations and practical applications of HTSC technology. In this program we propose to develop an innovative plasma-enhanced chemical vapor deposition process (PE-CVD), which can potentially reduce twining by growing the orthorhombic superconducting phase in the as deposited state at low temperatures and reducing defects by suppressing the formation of impurities via a selective plasma etching technique. Moreover, PE-CVD is an attractive process due to its large-area, low temperature, high growth rate, and low cost fabrication capabilities. Phase I work will emphasize the feasibility demonstration of epitaxially growing the multilayer junction structure by the PE-CVD process.

ODYSSEY RESEARCH ASSOC.
301 DATES DRIVE
ITHACA, NY 14850
Phone: (607) 277-2020

Topic#: 93-057
Office: ES3
Contract #: F30602-93-C-0138
PI: Mark Bickford

ID#: 93ES3-179

Title: Formal Verification of VHDL Models

Abstract: The goal of this project is to create tools to support the formal verification of VHDL designs. Two existing formal verification tools will be enhanced to support VHDL. The first, Spectool, will allow a class of designs, the synchronous finite-state controlled systems, to be specified and verified and then translated into VHDL. This capability will allow VHDL to be used as an interface between Spectool, which has been used to verify several large designs, and other CAD tools. The second tool, Penelope, will be enhanced to allow specification and verification of arbitrary VHDL designs. Phase I will complete the enhancement of Spectool to allow translation of verified designs into VHDL. Examples will be worked using the enhanced tool and will guide the development of the VHDL interface language to be used in the VHDL-enhanced Penelope. Penelope will be enhanced to support the core language constructs of VHDL, laying a foundation for the Phase II effort. In Phase II of the project, the VHDL-enhanced Penelope system will be completed to support all of VHDL and integrated with the Ada part of Penelope so that mixed hardware/software systems can be verified.

OPERATIONAL TECHNOLOGIES CORP.
4100 NW LOOP 410, SUITE 230
SAN ANTONIO, TX 78229
Phone: (210) 731-0000

Topic#: 93-023
Office: AL
Contract #: F41624-93-C-4000
PI: CB Harrah

ID#: 93AL-235

Title: Development of a Technology Transfer Work Station

Abstract: The objective is to develop a computer-based technology transfer workstation to aid in the transfer of technology from federal laboratories to the private section. The technology transfer workstation will incorporate a decision support system (DSS) that will contain specific documents an data elements necessary to support management decisions concerning the selection of candidate technologies. Previous methodologies for technology transfer have focused on educating potential markets through mainly passive means, i.e., seminars and meetings and through information transfer through informal channels. OpTech proposes to support federal laboratory managers and scientists with a structured decision support system resident on a technology transfer workstation. Technologies from the fields of R&D management, decision analysis, document imaging and retrieval systems, and legal and administrative review will be combined within the DSS. In Phase I, we will (1) review current literature on information management and technology transfer: (2) determine the informational flow requirements between internal and external agencies, (3) define mandatory DSS data elements, and (4) design a prototype workstation. The prototype DSS and workstation will be developed in Phase II.

OPERATIONAL TECHNOLOGIES CORP.
4100 NW LOOP 410, SUITE 230
SAN ANTONIO, TX 78229
Phone: (210) 731-0000
Topic#: 93-023
Office: AL
Contract #: F41624-93-C-4001
PI: CB Harrah
ID#: 93AL-236

Title: Decision Support System for Research & Development Investment Strategy

Abstract: The objective is to develop an expert system to serve as a decision aid to support resource allocation decision making in the Air Force Human Systems Center research and development community. This decision aid will incorporate the best methods for categorizing, prioritizing, and allocating resources to the most promising projects. Previous methodologies for program planning have tended to be narrowly focused along technical disciplines, not integrative across disciplines. We propose to combine ideas from the fields of R&D management, decision analysis, expert systems, fuzzy logic, and polynomial network modeling into a unified methodology. In Phase I, we propose to: (1) review the current status of cost/benefit analysis and the assessment of the utility/worth; (2) develop measures of benefit for human-centered research, (3) develop and apply a resource allocation methodology, and (4) develop an initial implementation of the methodology on a microcomputer system. In Phase II, the computerized implementation will be developed fully. The Phase II development will permit R&D managers to allocate resources across many different projects and estimate the comparable worth of each effort.

OPTI-LOGIC CORP.
P.O. BOX 2002
TULLAHOMA, TN 37388
Phone: (615) 454-0897
Topic#: 93-003
Office: AEDC
Contract #: F40600-93-C-0005
PI: Patrick J. Murphy
ID#: 93AED-036

Title: Scanning Infrared Viewer for Turbine Engine Internal Surfaces

Abstract: A scanning infrared viewing system is proposed for mapping the radiation emitted by the internal surfaces of turbine engines. The viewing system will consist of a rotating, traversing probe housing that will be inserted in the exhaust nozzle of the engine during tests conducted in AEDC test cells. The viewing system will provide point-to-point mapping of emitted radiation which will then undergo image processing to produce the final image. During the Phase I effort, the feasibility of the proposed approach will be demonstrated both analytically and through a bench top demonstration. Final design, fabrication, and testing of the full-scale development system will be conducted during Phase II of the program.

OPTICAL AIR DATA SYSTEMS L.P.
P.O. BOX 7836
VAN NUYS, CA 91409
Phone: (818) 997-3636
Topic#: 93-123
Office: WL4
Contract #: F33615-93-C-3603
PI: Philip L. Rogers
ID#: 93WL4-052

Title: Dual use Optical Non-obtrusive Air Data Measurement System

Abstract: An innovative electro-optical dual use primary air data system concept is proposed for test and evaluation which will provide very accurate airspeed, angle of attack, and angle of sideslip information. Patented technology will allow a compact, lightweight, and eye-safe laser velocimeter system to be constructed for airborne use. Phase I of the program will involve preliminary ground testing of an existing proof-of-concept prototype unit to establish suitability as a primary aircraft air data sensor. Phase II is contemplated to flight test a three axis sensor into the supersonic and high angle regimes with a fully capable prototype system designed to measure submicron particles at altitudes in excess of 75,000 feet.

OPTICAL CONCEPTS, INC.
P.O. BOX 668
LOMPOC, CA 93438
Phone: (805) 737-7391
Topic#: 93-054
Office: ES3
Contract #: F19628-93-C-0088
PI: M. KEVIN KILCOYNE
ID#: 93ES3-135

Title: Strained-layer Quantum-well Laser Structures for Microwave Applications

Abstract: High-speed analog optical links for microwave and millimeter wave transmission require new designs for semiconductor lasers, to extend their performance. Laser bandwidths are presently limited by the small differential gain coefficient of the bulk material. This proposal describes a technical approach which will overcome these limitations and allow fabrication of lasers with modulation bandwidths well beyond 30 GHz. The approach takes advantage of the smaller dimensions of vertical cavity surface emitting lasers (VCSELs) which result in increased relaxation oscillation frequency and significantly improved

101

damping of the response. These limitations in VCSELs are significantly improved over those in in-plane lasers. Very high relaxation oscillation frequencies have been demonstrated. A resonance frequency per square root power coefficient of 7.6 GHz per square root milliwatt has been determined using relative intensity noise measurements, and a maximum relaxation oscillation frequency of 71 GHz was observed by streak camera measurements, on an 8 micrometer square VCSEL. Since this performance was obtained at 980 nm wavelengths, the goal of this effort is to develop 1310 and 1550 nm VCSELs with similar or improved high frequency performance. By using VCSELs, we believe that arrays of high-speed microwave optical sources can be produced at low cost.

OPTICAL ETC, INC.
3077 LEEMAN FERRY ROAD
HUNTSVILLE, AL 35801
Phone: (205) 880-8207
Topic#: 93-106 ID#: 93PL6-014
Office: PL6
Contract #: F04704-93-C-0016
PI: Dr. Arthur Werkheiser
Title: Microelectromechanical Gyroscope Device for Navigation
Abstract: Microelectromechanical sensors (MEMS) offer an excellent opportunity for high reliability, small-package systems for applications in industry and defense. Micromachining techniques used in conjunction with commercial CMOS technology results in low-cost devices that also have as an integral part the necessary electronics for analysis and control of the MEMS. The proposed effort employs a MEMS accelerometer sensor as a component of a MEMS gyroscope. The device will have on-board electronics for functional control and signal analysis, fabricated in commercial CMOS foundries. This will keep the device relatively inexpensive, yet reliable, rugged, and compatible with standard computer interfacing. Phase I research will explore the capabilities of a cantilever-style accelerometer. An array of accelerometers with a minimum of electronic I/O will be designed and fabricated in a commercial CMOS foundry. Post-processing will develop the accelerometer itself. Testing of the chip will determine the ruggedness, sensitivity, precision and temperature dependence of the sensor. Phase II research and development will explore combining several accelerometer stages into an angular acceleration sensing device. Design goals include a small, self-contained device that measures linear and angular acceleration and computes position in real time.

OPTICOMP CORP.
PO BOX 10779, 215 ELKS POINT RD
ZEPHYR COVE, NV 89448
Phone: (702) 588-4176
Topic#: 93-035 ID#: 93ES3-217
Office: ES3
Contract #: F30602-93-C-0135
PI: Peter S. Guilfoyle
Title: Global Free Space Smart Optical Interconnects for C3I Computational Technologies
Abstract: Solicitation AF93-035 requires the development of innovative concepts for increasing the war-fighting capabilities of the Air Force command, control, communications and intelligence (C3I) investigation. The proposed effort addresses the establishment of planar (N4) and volume (N5) "smart" global (multi-dimensional) optical interconnects for digital optoelectronic computing hardware. The purpose of the program is to define, develop, and map C3I algorithms and related subroutines into 4-dimensional optical interconnects. Once mapped efficiently, these optical interconnect configurations are to be incorporated into 2-dimensional planar holographic optical interconnect (hardware) elements (HOIEs). Ultimately, reconfigurable 3-dimensional volume holographic optical interconnects elements (V-HOIEs) for N5 "smart" optical interconnects will be incorporated into the final design. By implementing "smart" pixel technology coupled with free space global optical interconnects, two primary objectives will be accomplished. The first objective is to generate algorithms and subroutines for mapping into 2D arrays (32 x 32) of thin planar holographic optical interconnects (HOIE) as well as the HOIE hardware technology required. This HOIE program will be leveraged with current 2-D GaAs DANE (detection, amplification negation and emission) technology. The second objective is to focus on a 3D volume interconnect technology for reprogrammable N5 topologies.

OPTIMIZATION TECHNOLOGY, INC.
6767 MADISON PIKE NW, SUITE 600
HUNTSVILLE, AL 35806
Phone: (205) 721-1288
Topic#: 93-109 ID#: 93WL2-044
Office: WL2
Contract #: F33615-93-C-1258
PI: Trace Parish
Title: A Comprehensive Approach for Design Complexity Analysis of Avionics Software
Abstract: Due to the fairly recent acceptance of software metrics collection techniques, comparative measures of software

attributes such as complexity, usability, and quality are not being used for the evaluation of end-product source code. Unfortunately, the problems found are often due to an overly complex or faulty design specification requiring a post-implementation redesign phase. OTI proposes to shorten this loop by defining a comprehensive approach for the application of complexity metrics to the design specification prior to implementation. Emphasis of all work will be placed on the special problems encountered by developers of avionics software. A four part effort will be performed in Phase I: 1) an investigation of tools and methodologies currently available for analysis of design complexity; 2) a determination of areas specific to avionics which have not been addressed; 3) the presentation of innovative solutions to the areas found in area 2; and 4) the definition of requirements for a tool to automate these solutions.

OPTITRONICS
2218 HERITAGE WAY
FULLERTON, CA 92633
Phone: (714) 992-1167

Topic#: 93-106
Office: PL6
Contract #: F04704-93-C-0014
PI: Young H. Kim

ID#: 93PL6-043

Title: Neural Network Based Processing Platform for Navigation and Control

Abstract: OptiTronics will undertake a design and implementation effort to develop a general purpose processing system that can be used for implementing artificial neural networks or large scale parallel multiprocessors. The system hardware is based on digital signal processors (DSPs) organized as a multiprocessor computing platform. The proposed system can be used as a decision module in sensor/data fusion systems where large number of processing elements will enable the processing of large number of sensor signals in real time. Also, the proposed system can be used as a general purpose multiprocessor for distributed or parallel processing. The small system size requirement will be satisfied by employing 3D electronic packaging structure with a vertical integration of several VLSI electronic layers in a multiple-plane configuration. The high flexibility of the system will be obtained by combining a reconfigurable electronic hypercube interconnection network together with an optical crossbar interconnection network to achieve high speed global data transfer among processors. Design of an efficient operating system for this multiprocessor is considered one of the important tasks for this Phase I program. It is expected that the proposed system will have high processing power of - 7 GFLOPS.

OPTIVISION, INC.
4009 MIRANDA AVE.
PALO ALTO, CA 94304
Phone: (415) 855-0200

Topic#: 93-053
Office: ES3
Contract #: F30602-93-C-0149
PI: Dr. Matthew H. Derstine

ID#: 93ES3-129

Title: Free Space Parallel Optical Memory Interconnects

Abstract: The problem addressed in this proposal is the need for a highly parallel, switchable, high data rate interconnection system suitable for interfacing optical memory systems, optical and electronic processors, and other subsystems. The novelty of our approach is as follows. First we use a free-space, parallel, optical ring network for the basic bus interconnection topology. Second, we define optical interfaces to the network that provide optical format conversion so that the data format in the subsystem can be matched to the data format on the network. Third, our interfaces are based on recent advances in design and fabrication of smart pixel optoelectronic arrays. We will explore alternative architectures, including switched interconnections, beam steering, and ring network topologies. Our system design will take advantage of emerging device and packaging technologies and will exploit Optivision's experience with other interconnection subsystems. An interconnect architecture will be selected and performance models developed. These investigations will also suggest limitations of current smart pixel, packaging and integration technologies in terms of the optical performance, power dissipation and types of functions that can be performed. An optional task will demonstrate use of two-dimensional arrays for conversion of optical data from one format to another.

OPTRA, INC.
461 BOSTON STREET
TOPSFIELD, MA 01983
Phone: (508) 887-6600

Topic#: 93-076
Office: PL1
Contract #: F29601-93-C-0045
PI: Gregory Zimmerman

ID#: 93PL1-274

Title: Phase Modulated Fiber Optic Link with Up to 20 Gigahertz Bandwidth and 40dB Dynamic Range

Abstract: OPTRA has identified an approach for using Integrated Phase Modulators (IPM) to optically measure voltages in an

anechoic chamber which is unique, innovative and superior to any other method currently in use. We propose the use of an IPM to phase shift the two propagation eigen-modes of a highly birefringent optical fiber and to directly recover this phase, which is proportional to the voltage being measured, using a method which is independent of the operating point of the system. This system will use a continuous wave (CW) fiber coupled diode pumped solid state laser source to achieve high signal to noise ratio shot noise limited performance. OPTRA's method of phase detection removes the +-1/8 cycle (45 degrees) maximum phase excursion which is typical of Mach-Zehnder amplitude modulators and extends the dynamic range to cover the full potential of the IPM device. This translates to a factor of 40 increase in dynamic range for commonly available IMP devices. The maximum modulation rate for OPTRA's approach is limited only by the IPM and not by laser chirp or non-linear amplifier effects as in direct amplitude modulation. The maximum modulation rates reported using Lithium Niobate waveguide based IPM are around 20GHz.

ORBITAL TECHNOLOGIES CORP.
402 GAMMON PLACE, SUITE 10
MADISON, WI 53719
Phone: (608) 833-1992
Topic#: 93-092 ID#: 93PL3-063
Office: PL3
Contract #: FO4611-93-C-0085
PI: Dr. Eric E. Rice
Title: Prototype Storage and Delivery Device for Cryogenic Solid Hydrogen Propellants-A
Abstract: ORBITEC proposes to develop a means to produce and utilize cryogenic solid-based hydrogen fuels in a combustion chamber. Controlled freezing from the gaseous phase at or below the triple point assures uniform solid phase formation directly from gaseous phase. The vapor pressure of hydrogen is negligible at temperatures below 10K (< 0.1psi), and sublimation rates would be negligibly slow. We propose to accomplish the hydrogen solidification by means of an LHe chilled heat sink and to control the rate of solidification by the hydrogen delivery pressure, liquid helium flow rate, and surface area condition. During Phase I, the solidification process will be demonstrated with existing, new, and/or modified hardware. During Phase II, we will integrate into the Phase I hardware design the capability for combining energetic atoms with the solid hydrogen to form a high-energy-density solid. Additionally, a Phase II test-bed storage and delivery device (5-lb, thrust engine) will be designed, developed, tested, delivered, and integrated at the USAF/PL Propulsion Laboratory at Edwards AFB.

ORINCON CORP.
9363 TOWNE CENTRE DRIVE
SAN DIEGO, CA 92121
Phone: (619) 455-5530
Topic#: 93-059 ID#: 93ES3-195
Office: ES3
Contract #: F30602-93-C-0133
PI: Ms. Sharon M. Fritz
Title: Real-time High-performance Software Visualization Tool
Abstract: Graphical depiction would be a more useful and easily comprehended method of verifying real-time software performance than methods currently in use. It could be applied across a wider range of applications to increase real-time software reliability and decrease development costs. ORINCON proposes an innovative method for dynamically displaying real-time software timing information, This method would provide the capability to collect timing data for a real-time system and replay it using time lines and color coding to show the relationship of execution times to budgets. Displays would be shown in layers so that timing could be analyzed at different levels, from the top-level system processes down to the subroutine level. Processor loading also would be displayed. The collected timing data would be replayed at an operator-selected speed to aid in understanding. Static graphs of cumulative statistics, such as average execution time, would also be provided. In this method, the decoupling of the display of the timing data from its collection would not only permit the replay to be done at a selectable speed, but also would be a key factor in minimizing the effort required to evaluate real-time software performance on different target hardware.

ORINCON CORP.
9363 TOWNE CENTRE DRIVE
SAN DIEGO, CA 92121
Phone: (619) 455-5530
Topic#: 93-069 ID#: 93PL1-124
Office: PL1
Contract #: F29601-93-C-0093
PI: DR. ROBERT N. LOBBIA
Title: Autonomous Neural Control of Space Platforms
Abstract: ORINCON proposes to develop an Adaptive Neural Controller (ANC) based on the extended Kalman filter (EKF) principle, which requires neither the controlled process (or plant) nor the control to have fixed, parameterized structures, as a

superior method of performing identification of flexible zero-gravity structure dynamics. To demonstrate that an ANC can perform unsupervised identification of a dynamic model, a software-based ANC will produce a plant identification for a model of a simple beam structure. Model response will be calculated from a finite number of bending moments to generate training data. The control scheme will use an EKF on the first five beam moments plus the neural network. The neural network will reduce the error between the model's response and the EKF output. A final report will describe the system configuration, analyze test results, and make recommendations for future investigation. We anticipate that ANCs can provide real-time stabilization of large structures more accurately than traditional control of space structures with a wider range of unknown parameters than are other conventional controllers, and is generally applicable to mechanical structure control and robotics.

P. NICHOLAS LAWRENCE
227 EDGEVALE
SAN ANTONIO, TX 78229
Phone: (210) 349-5666
Topic#: 93-091 ID#: 93PL3-023
Office: PL3
Contract #: FO4611-93-C-0083
PI: Dr. P. Nick Lawrence
Title: A Potentially Simple Pathway to Cubane and Its Derivatives
Abstract: Current methods of cubane synthesis attempt to produce cubane by direct synthesis through irreversible chemical reactions. The presence of so many highly strained rings in cubane complicates this method. We propose an alternative method to the production of cubane that takes advantage of its unusual physical properties. If our method works, we will detect cubane in small amounts in the Phase I effort. Phase II would then be an attempt to improve the process to the point that it becomes an economically viable way to produce cubane in commercial quantities. The great appeal of the method is that if it works, cubane production will be relatively cheap and easy, and the method will also apply to the production of cubane derivatives.

P. NICHOLAS LAWRENCE
227 EDGEVALE
SAN ANTONIO, TX 78229
Phone: (210) 349-5666
Topic#: 93-164 ID#: 93WL0-025
Office: WL0
Contract #: F08630-93-C-0029
PI: Dr. F. Nick Lawrence
Title: Sensor Fusion with Dataware Engineering
Abstract: Dataware engineering is an emerging methodology for the application of neural networks and associated techniques to specific problems. It is based on a comprehensive theory of systems that learn from experience and reason by analogy, called "correlithms." Research into dataware engineering has recently suggested a new and potentially very powerful analysis methodology for coordinating data from a variety of sources. (This coordination is commonly called "sensor fusion.") If found feasible, this approach will allow the design and implementation of generic systems capable of utilizing data from diverse sources to produce a single environmental perspective, in other words, "situationally aware" systems. This project will test this approach on a problem to be jointly developed with the Office of Primary Responsibility.

PACIFIC RIM ENGINEERING
P.O. BOX 5639, 8055 MANCHESTER AVE, STES 203-4
PLAYA DEL REY, CA 90296
Phone: (310) 823-7234
Topic#: 93-014 ID#: 93AFC-207
Office: AFCESA
Contract #: FO8635-93-C-0115
PI: HARRY NELSON
Title: Water Containerization and Distribution System for Arctic Use
Abstract: The purpose of this Phase I study is to develop a potable water containerization and distribution system for bare base installation in arctic environments. The study will develop various system concepts for the water system and trade off the materials and devices of each system for a down select decision to a system which will be more fully developed. Key requirements for the system include the ability to reliably deliver water to points remote from the supply source at a rate of 200 gallons per day in an environment where the temperature can be a -70 degree Fahrenheit, a system that has minimum weight to water ratio and which can be set up in less than six (6) hours. Both automatic controlled systems and man portable containerized systems will be studied. A block diagram of the system will be developed and equipment will be selected or designed for each block of the system. Each selected piece of equipment will be analyzed for performance in the environment, weight, reliability, maintainability, and power consumption for pumping and heating. A total system weight analysis will be performed to demonstrate a viable system weight to water weight ratio. An assessment of the system set up time by persons dressed for the arctic environment will be included. Several existing cold weather studies will be evaluated for application to

107

this study, and several existing military insulated containers will be evaluated for use.

PACIFIC-SIERRA RESEARCH CORP.
2901 28TH STREET
SANTA MONICA, CA 90405
Phone: (310) 314-2300
Topic#: 93-102 ID#: 93PLA-088
Office: PLA
Contract #: F19628-93-C-0102
PI: Richard D. Small
Title: Heated Cloud Rise Model
Abstract: SECA, Inc. with the support of MESO, Inc. proposes to develop a Heated Cloud Rise Model needed for accessing environmental issues associated with rocket engine/vehicle testing. A predictive tool to describe the environmental impact of rocket exhaust plumes from nominal launches and ground tests, propellant burns, and vehicle aborts will be developed. Noxious pollutants, primarily HCl, which are expelled as combustion products from rocket engines, can cause acid rain. Smokey particulates must also be controlled or eliminated. Having the ability to quantitatively evaluate the dispersion and ultimate deposition of such exhaust products will provide an estimate of the environmental impact of engine testing and a measure of the efficiency of possible control procedures.

PD-LD, INC.
1061 GREAT ROAD
PRINCETON, NJ 08540
Phone: (609) 924-7708
Topic#: 93-019 ID#: 93AFO-023
Office: AFOSR
Contract #: FQ8671-9301361
PI: Dr V.S. Ban
Title: Infrared Detectors Based on Si/SiGe Superlattices and Silicide/SiGe Schottky Barriers Operating Beyond 12 microns
Abstract: In this proposal, we describe plans to extend, for the first time, the operation of the detectors based on silicon like materials and technology to 12um and beyond. The materials we propose are the SixGe1-x alloys. Two types of detectors will be investigated: (a) Detectors based on Silicide/SixGe1-x Schottky barriers, and (b) Detectors based on SixGe1-x/Si multiquantum wells. The work will be done in cooperation with Professor J.C. Sturm from the Princeton University and Professor W.F. Kosonocky from the New Jersey Institute of Technology. The reliability and the cost effectiveness of SiGe based detectors easily surpasses the MCT and MWQ III-V detectors, thus making them very attractive for a variety of civilian and military uses. We believe that this proposal adequately addresses the following important issues in the detection of the LWIR radiation: operation beyond 12um, operation at 77oK and above, operation at normal angle of incidence and utilization of reliable and cost effective materials and technologies.

PECKHAM ENGINEERING & TOOL
1151 5TH ST.
MANHATTAN BEACH, CA 90266
Phone: (213) 378-4327
Topic#: 93-065 ID#: 93PL1-112
Office: PL1
Contract #: F29601-93-C-0103
PI: V. A. PECKHAM JR.
Title: Precision Linear Flexure Bearing Cartridge
Abstract: Segmented diaphragm linear flexure bearings are the single major innovation which has extended the service life of linear drive cryocoolers from a 4,000 hour mean time to failure to a potential 80,000 hour operational life. Unfortunately, the design, fabrication, installation, and alignment of such bearings is an art. Material selection, fabrication processes, quality control, allowable cyclic stress, dynamic behavior, mounting provisions, alignment processes, radial/axial stiffness, and the establishment and maintenance of radial clearances are reoccurring problems with each new application. The spiral cut diaphragm is the prevalent configuration. The three leg tangential configuration is a recently described alternative with lower peak stress per unit radial stiffness. This improvement does not resolve the design, fabrication, installation, and alignment problems. This project will examine and compare the spiral and tangential flexure for designing reproducible, highly reliable, long life, radially stiff elements for assembly in integral precision cartridges. The innovative aspect is to develop a metallurgically bonded precision aligned integral bearing cartridge with tight tolerance internal and external mounting diameters. Such cartridges, externally similar to ball bearing cartridges, will greatly simplify the use of these bearings. The metallurgical bonding process will be demonstrated and evaluated.

PERSONNEL DECISIONS RSCH INSTITUTE
43 MAIN STREET SE, SUITE 405
MINNEAPOLIS, MN 77488
Phone: (612) 331-3680
Topic#: 93-030 ID#: 93AL-039
Office: AL
Contract #: F41624-93-C-5004
PI: Jerry W Hedge
Title: Computer Based Assessment of Pilot Personality
Abstract: PDRI proposes to develop a computer-administered and scored situational judgment inventory to predict combat pilot performance. Situational judgment inventories present respondents with a series of job-relevant situations and ask them to indicate which of several alternative actions would be most effective and which would be least effective in each situation. This inventory will consist of items describing pilot-relevant situations that tap personality dimensions important for effective functioning as a combat pilot, and that are not measured adequately by the AFOQT or the BAT. We also plan to develop a software shell to administer and score the inventory. This shell will be compatible with the BAT/PORTABAT software, and will be flexible enough to permit the administration and scoring of almost any multiple-choice test. Phase I efforts will entail deciding upon personality constructs to measure using the inventory, developing four or five situational judgment inventory items tapping each of those constructs, designing demonstration software to administer the items, and establishing plans for the development of a flexible software shell.

PHD RESEARCH GROUP, INC.
P.O. BOX 248433
CORAL GABLES, FL 33124
Phone: (305) 284-2022
Topic#: 93-086 ID#: 93PL1-054
Office: PL1
Contract #: F29601-93-C-0074
PI: DR. SANJAY K. ROY
Title: A Very High Heat Flux Microchannel Heat Exchanger and Fluid
Abstract: A research proposal to develop a very high heat flux heat exchanger to cool semi-conductor laser arrays is presented. The proposed design will be based on currently available microchannel heat exchangers. In order to enhance their performance so that they may be used for the proposed application, a phase change material suspension will be used as the heat transfer fluid. Unlike conventional phase change material suspensions which use microencapsulated phase change materials, and emulsion type suspension will be used in this design because of its lower cost, higher stability and longer life, as well as many other advantages. During the Phase I investigations, the heat transfer performance of a microchannel heat exchanger with phase changer material suspensions will be evaluated. In addition, experiments will be done to verify that the system performance is up to the required criteria, viz. 1000W/cm2 at 300K.

PHOTOMETRICS, INC.
4 ARROW DRIVE
WOBURN, MA 01801
Phone: (617) 935-6500
Topic#: 93-097 ID#: 93PL4-006
Office: PL4
Contract #: F19628-93-C-0059
PI: Dr Michael Burka
Title: Infrared All-sky Imaging System for Measurement of Cloud Properties
Abstract: Effective utilization of Air Force electrooptical systems requires precise measurement of cloud properties with high spatial and temporal resolution. Radiative interactions of clouds with the thermal and optical emissions of targets and with the ambient background radiation field affect the ability to detect and track targets traveling through cloud filled skies. The results of the FIRE program concerning the sensitivity of IRST systems show how important the effects of cloud backgrounds can be. The proposed research will examine the degree to which passive infrared remote sensing technology can determine the microphysical and optical properties of clouds. We will design an all-sky imaging system that measures cloud thermal radiances at a few closely spaced wavelengths within each of the 305u and 10-12u atmospheric windows to determine cloud temperatures and IR emissivities and other microphysical properties. Polarization measurements of scattered solar IR will give information about the ice structure of clouds.

PHOTON RESEARCH ASSOC., INC.
1911 N. FT. MYER DR., SUITE 408
ARLINGTON, VA 22209
Phone: (703) 243-6613
Office: PL1
Contract #: F29601-93-C-0087
PI: JOHN KOGUT
Title: Innovative Modeling Techniques for End-to-end Simulations of Spacecraft Sensor Systems

Abstract: Integrated, modular, and easy to use digital simulations of the end-to-end performance of spacecraft sensors, structures, and supporting subsystems can provide powerful insights into many systems. This includes surveillance satellites and related spacecraft weapon and remote sensing systems. Such simulations can support a wide range of functional capabilities in the design, development, and operational life cycle of such spacecraft. Traditional approaches to end-to-end system modeling have produced very large computer programs not conducive to interactive usage. The rapidly evolving capabilities of computer workstations, new system programming environments, and advanced graphics and user interfaces, however, provide a new capacity to integrate hitherto separate computer models operating in different environments into interactive high fidelity system simulations. This project will develop a design and proof-of-concept kernel for an end-to-end simulation of the critical elements of a space-based passive sensor system by applying these new workstation tools and software development techniques. This design will be an initial step in providng an integrated set of spacecraft/sensor system engineering and analysis tools.

PHOTONICS RESEARCH, INC.
4840 PEARL EAST CIRCLE, SUITE 200W
BOULDER, CO 80301
Phone: (303) 541-9292

Topic#: 93-168
Office: WL0
Contract #: F08630-93-C-0037
PI: Robert P. Bryan

ID#: 93WL0-097

Title: Phased Arrays of Vertical-cavity Surface-emitting Lasers as 2D Input Sources for Optical Processors

Abstract: We will design, fabricate and characterze 2D phased arrays of vertical-cavity surface-emitting lasers for use as input sources in optical processors. In Phase I we will: 1) evaluate approaches for realizing 2D phased arrays and select the most promising candidate; 2) design the material structure and fabrication process for the phased array; 3) fabricate and characterize the phased array; 4) investigate means for producing 2D phase-locked images; 5) design a processor architecture using the phased arrays; and 6) develop a plan for a Phase II prototype system and Phase III commercialization. 2D phased arrays represent an attractive alternative to spatial light modulators by having higher speed and compatibility with low voltage electronic chips. Also use of light sources rather than modulators dramatically simplifies the optical system. Phase-locked laser arrays have been demonstrated by several groups but efforts have not yet been made to incorporate them into parallel optical processing systems. PRI's experience in laser arrays and optics make the likelihood for success in this program extremely high. We will also interact closely with the contracting organization to insure a smooth technology transfer of the enabling technology into the processor under development in the Armament Directorate at Eglin AFB. Additionally, the technology developed will address many other military and commercial applications.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 320-3088

Topic#: 93-035
Office: ES3
Contract #: F30602-93-C-0135
PI: Taiwei Lu, PhD

ID#: 93ES3-218

Title: Miniaturized Holographic Digital Optical Processor for High Speed Computing and Signal Processing

Abstract: The demand for high computational power requires parallel processing and massive interconnection. Physical Optics Corporation (POC) has successfully constructed a bench-top holography-based digital optical processor (HBDOP) and demonstrated 32 x 32 hologram array symbolic substitution, hypercube interconnection, and 64 digital processors operating in parallel to perform digital operations such as morphological functions, simple target tracking and noise removal operations. POC proposes here a miniaturized HBDOP system that utilizes a specially designed optical imaging system to reduce the size of the HBDOP system. The proposed project will refine the holographic array recording system to produce larger scale (128 x 128) subholograms and smaller size (500 x 500 um2) hologram arrays for massive interconnection and parallel processing not achievable by VLSI. POC will also explore applications of this HBDOP system to high-speed radar signal processing, morphological image processing and neural network target recognition operations. At the end of Phase I, an engineering design of a prototype miniaturized HBDOP system will be provided for Phase II fabrication. Based on the experience gained in previous projects with the Air Force and the high caliber of the project team, the probability of success in this program is very high.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501

Topic#: 93-036
Office: ES2
Contract #: F19628-93-C-0149

ID#: 93ES2-118

Phone: (310) 320-3088 PI: Alexander Rizkin, PhD

Title: Tunable Narrow Band Optical Filters for Electro-optic Diagnosis

Abstract: Physical Optics Corp (POC) proposes a novel Tunable Vernier Holographic Fabry-Perot Filter (TVH FPF) based on a double cavity vernier Fabry-Perot etalon using holographic coherently coupled cavity mirrors. This Fabry-Perot etalon can be used to diagnose the deviation of optical wavelength and/or beam angle, thus predicting or identifying failures in electro-optic and photonic systems. The successful design can be achieved by using two of POC's existing technologies: high-efficiency volume holography and a coherently coupled, tunable, holographic Fabry-Perot filter. The FPF will be combined with a tunable double-cavity vernier configuration using a relatively ordinary low-finesse FP cavity which is independently tunable over a small portion (1/20) of the spectral range covered. As a result, a high-resolution vernier effect over the fully covered spectral range is obtained. The proposed TVH FPF will, at low cost, exhibit narrow-band (1A or less) tunability to any arbitrary wavelength within a spectral range of at least 100 nm in the visible (including the blue-green) or the IR. In addition, because of the nature of the coherently coupled recording of the holographic mirrors, large-aperture TVH FPFs can be fabricated.

PHYSICAL OPTICS CORP. Topic#: 93-043 ID#: 93ES3-026
20600 GRAMERCY PLACE, SUITE 103 Office: ES3
TORRANCE, CA 90501 Contract #: F19628-93-C-0083
Phone: (310) 530-1416 PI: Z. Z. Ho, Ph.D.

Title: Guided Wave Holography Based on Polyimide Composites with Real-time Capability and Semi-conductor Electronic Compatibility

Abstract: Holograms offer the ability to reconfigure free space and waveguide optical interconnects in real-time. As photonic devices become more sophisticated, it is important to explore holographic materials that provide substantial performance advantages in terms of speed, power, budget and diffraction efficiency. Physical Optics Corporation (POC) proposes to fabricate a highly diffractive polyimide-based composite for real-time holographic materials, resulting in a totally new concept incorporating POC's birefringent dye polymer into a polyimide matrix for building a large reconfigurable 2-D and 3-D network using wavelength-selective holograms. This program's success will exploit the advantages of polyimides, including good process ability, high thermal stability, low dielectric constant, excellent mechanical strength, and compatibility with silicon wafer technology. POC has developed a fast response, high diffraction efficiency birefringent material which will be incorporated in this new composite. The multiplexing of birefringent holograms makes the in- and out-of-plane coupling of guided waves feasible. The high optical qualities and multi-chip module (MCM) compatibility of polyimide thin film layers permit integration in guided wave devices with electrooptical modulators in a material system which is compatible with hybrid fabrication of semi-conductor electronics and laser diode sources.

PHYSICAL OPTICS CORP. Topic#: 93-050 ID#: 93ES3-099
20600 GRAMERCY PLACE, SUITE 103 Office: ES3
TORRANCE, CA 90501 Contract #: F30602-93-C-0140
Phone: (310) 320-3088 PI: Freddie Lin, Ph.D.

Title: A Self-routing Optical Interconnect Network Based on Holographic Associative Memory

Abstract: Physical Optics Corporation (POC) proposes a new self-routing technique which provides solutions to switching contention and multi-stage routing problems encountered by the conventional self- routing techniques such as TDM, WDM and CDM. Furthermore, a fiber optic delay line memory is introduced to eliminate the time synchronization and temporary storage problems of fiber optic data packet switching networks. As a result, three key devices are needed in the implementation of a self-routing network node. In addition to the fiber optic delay line memory, an optical switching array is used for data switching, and a digital optical associative memory (DOAM) is used as a self-routing switching controller. An engineering development model will be constructed in the Phase I program to demonstrate the key features of the proposed approach and its potential for use in high-speed self-routing networks.

PHYSICAL OPTICS CORP. Topic#: 93-052 ID#: 93ES3-108
20600 GRAMERCY PLACE, SUITE 103 Office: ES3
TORRANCE, CA 90501 Contract #: F30602-93-C-0144
Phone: (310) 320-3088 PI: Lev Sadovnik

Title: Multispectral Imager Utilizing A Variable Grating Mode LC Device Combined with a Fabry-Perot Etalon
Abstract: We consider multispectral imaging not just as a problem of providing a reconfigurable filter (variable Fabry-Perot etalon, acousto-optic tunable filter, light-induced holographic variable grating) but rather as a problem of overall system design. We find that the only variable dispersion element (VDE) capable of avoiding aliasing of the spectral images at the imaging (CCD) plane is a combination of a variable grating with a fixed Fabry-Perot etalon. We propose to build the VDE, using a variable grating mode (VGM) effect occurring in some liquid crystal (LC) mixtures. Under a dc voltage applied to such a mixture, a phase grating appears in the direction perpendicular to the quiescent state alignment of the LC molecules. Moreover, by increasing the dc bias we can linearly change the induced grating frequency over a wide range. Since the induced refractive index modulation is rather significant (up to 0.2) we expect to achieve theoretically limited diffraction efficiency. We propose a concept of a multispectral imager (MI) that combines the VGM device with an inexpensive, low-finesse, fixed Fabry-Perot (FP) etalon, and will select a narrow spectral band for each consecutive image. Thus, no image degradation is expected while rapid switching of spectral bands occurs. Phase I of this project will experimentally demonstrate the feasibility of the proposed VGM-FP combination for band-pass selection in the MI.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 530-1416

Topic#: 93-063
Office: PL1
Contract #: F29601-93-C-0082
PI: TOMASZ JANNSON, Ph.D.

ID#: 93PL1-113

Title: Optoelectronic MCMs and Boards Based on Light Distributing Interconnect Active (LIDIA) Substrates
Abstract: Physical Optics Corporation (POC) proposes a novel inter-MCM and intra-MCM optoelectronic interconnect, based on polymeric light distributing interconnect active (LIDIA) substrates. Based on indirect electrooptic (EO) modulation, and an external optical power supply, the LIDIA optoelectronic interconnects are radiation-hardened and fully-compatible with integrated-circuit technology. In contrast to previous optoelectronic interconnect concepts, these substrates will allow direct communication between silicon chips and MCMs, without the involvement of GaAs-chips. Also, they have higher reliability and much lower electrical power consumption. In addition, they can be physically scaled to the inter-MCM interconnect level without a costly modification of CMOS state-of-the-art technology. The LIDIA concept is supported by many POCs proprietary and patented technologies.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 320-3088

Topic#: 93-063
Office: PL1
Contract #: F29601-93-C-0083
PI: MICHAEL WANG, Ph.D.

ID#: 93PL1-241

Title: A New Architecture for Three-dimensional MCM Packaging Using Microprisms and Imaging Optical Tunnels
Abstract: Multi-chip modules are intended for use in high-performance electronic systems. One major limitation of packaged MCMs using electrical interconnects is the limited operating speed caused by relatively long electrical interconnect lines. Ohmic power losses, long delay times, and sensitivity to electromagnetic interference are some disadvantages. Optoelectronic interconnection, with speed and bandwidth independent of interconnection distance, is a potential replacement for electrical interconnects, particularly suitable for board-to-board three-dimensional MCM packaging as it will provide non-physical contact interconnection paths. Physical Optics Corporation proposes a new three-dimensional interconnection architecture for MCM packaging using waveguide modulators, microprisms (MP), and imaging optical tunnels (IOT). The new MP-IOT interconnect technique offers advantages for board-to-board MCM packaging: high speed and wide bandwidth interconnects (> GHz), lower power consumption at high data rates, low clock skew, low propagation loss, high packaging density, large fan-out density, non-physical contact board-to-board interconnects, low crosstalk, and reduced system sensitivity to EMI. The Phase I goal is to develop a small interconnect prototype and to demonstrate the feasibility of the proposed MP-IOT interconnect concept. Phase II research will produce a multi-element, fully integrated, MP-IOT-based MCM prototype system.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 320-3088

Topic#: 93-087
Office: PL1
Contract #: F29601-93-C-0075
PI: LEV SADOVNIK

ID#: 93PL1-189

Title: Fresnel Image Wavefront Sensor With High Sensitivity and Variable Spatial Sampling
Abstract: To reduce the complexity of Hartmann sensor optics and to adapt the wavefront sensor (WFS) to variable spatial sampling, Physical Optics Corp. proposes to design a novel WFS based on the Fresnal Image (FI) effect whereby a periodic structure illuminated by coherent light will image itself with variable multiplication depending upon the position of the observation plane. Local wavefront distortion (deviation from a plane or a spherical wavefront) causes displacement of corresponding elementary images constituting an FI of a periodic structure. A simple algorithm is proposed to compute wavefront local tilt from displacement measurement. The WFS has various advantages over other methods. The optical system is extremely simple, can be implemented in any spectral range, and give a clear two-dimensional pattern of inhomogeneities of the aerodynamic field. By selecting the transmittance profile of the elementary object, it is possible to adjust the WFS spatial sampling rate to the medium under investigation. The method can be used for long-aperture analysis and has higher sensitivity than the Hartmann method. A high rate of temporal sampling will be achieved by employing two 15KHz frame rate dedicated CCD arrays and POC's proprietary 48 DSP boards permitting highly parallel image processing.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CENTER
ANDOVER, MA 01810
Phone: (508) 689-0003

Topic#: 93-005 ID#: 93AED-058
Office: AEDC
Contract #: F40600-93-C-0010
PI: Evan R. Pugh

Title: High Speed Flow Visualization
Abstract: A flow visualization system is required to provide multiple imaging of real gas flow structure (shock stand-off distance, shock position, boundary layer) about aerodynamic shapes in transient, hypersonic ground test facilities at AEDC. Laser diodes do not provide enough light to overcome the background radiation from real gases. Recent progress and on going research on solid state laser systems, particularly work on alexandrite laser systems, suggest that they are candidates for the required light source. The high pulse energy of these laser sources make discrimination against flow and model radiation possible. The short laser pulses (<50 ns) will enable complex transient effects to be photographed without blurring. The laser will be the light source for standard flow visualization techniques (interferometer, schlieren, shadowgraph). The images will be captured using commercially available high speed cameras. This Phase I program will provide the conceptual designs, parametric studies and feasibility calculations and experiments required to design a low risk high speed flow visualization prototype system. In Phase II this prototype system will be checked out on the shock tube driven hypersonic tunnel at Physical Sciences Inc. (PSI) and then tested in a transient hypervelocity facility at AEDC.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CENTER
ANDOVER, MA 01810
Phone: (508) 689-0003

Topic#: 93-085 ID#: 93PL1-171
Office: PL1
Contract #: F29601-93-C-0072
PI: STEVEN J. DAVIS

Title: Diode Pumped 3 to 5 Micron Laser
Abstract: Diode laser pumped gas phase molecules offer an attractive solution to a current crucial Air Force need: efficient, compact, reliable and rugged lasers that operate in the 3 to 5 and 8 to 12 micron wavelength range. Direct diode laser pumping or excitation via diode laser pumped solid state lasers both offer attractive features. From an efficiency and size perspective, the best solution is probably the direct diode laser pumped approach. However, this may be a longer term solution since high power diodes are still under development. In this proposal, we describe a program that will identify and demonstrate efficient laser pumped gas phase lasers that operate in the 3 to 5 micron wavelength region. We will develop and apply a screening methodology to identify and prioritize attractive candidate molecules. In addition, using existing equipment, we will demonstrate efficient laser oscillation on one or two of the most attractive candidates. We will also design a Phase II program that will extend the approach to the 8 to 12 micron range and develop an efficient prototype laser for Air Force applications. These lasers would also have a considerable commercial market.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CENTER
ANDOVER, MA 01810
Phone: (508) 689-0003

Topic#: 93-130 ID#: 93WL4-131
Office: WL4
Contract #: F33615-93-C-3003
PI: Keith McManus

Title: Pulsed Vortex Generator Jets for Active Control of Flow Separation
Abstract: A program for the development of a flow actuator for active control of flow separation on flight surfaces is proposed. The actuators will be used to modulate flow through discrete jets located on the aerodynamic surface. These jets (known as Vortex Generator Jets or VGJ's) produce stream-wise and ring vortices which enhance boundary layer mixing and inhibit flow separation. This actuation technique lends itself to the development of a closed-loop active control system for flow separation control on aircraft flight surfaces because of the potential compactness of each actuator element and the simplicity of their operation. The ability to implement the control system only when necessary will allow improved aircraft performance over an extended flight envelope. In the proposed work plan, a flow visualization technique based on laser-induced fluorescence of a molecular flow tracer will be used to study the effects of this actuation technique on a separated flow surface. The influence of modulation frequency and amplitude on the effectiveness of this control scheme will be determined. The experimental results will be used as guidelines for the design of a Phase II prototype actuator for large-scale testing at flight conditions.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CENTER
ANDOVER, MA 01810
Phone: (508) 689-0003
Topic#: 93-157 ID#: 93WL6-082
Office: WL6
Contract #: F33615-93-C-2334
PI: TERENCE E. PARKER
Title: Ultraviolet Fluorescence Detection of Underground Fuel Spills
Abstract: Physical Sciences Inc. (PSI) proposes to devel p a fuel tank leak monitor based on the absorption/fluorescence properties of hydrocarbon fuels. This monitor would be buried next to fuel tanks in "tank farms" and would provide a direct indication of fuel leaks in the field. The Phase I effort will be focused on validating the fluorescence concept as a monitor for fuel tank failures and starting the development process which transforms a laboratory concept into a field worthy and fully tested instrument. The fluorescence fuel detection system is based on the red shifted fluorescence emitted by a fuel irradiated with ultraviolet light. Typical hydrocarbon fuels (for example, JP-4 and JP-5) absorb strongly for wavelengths less than 380 nm and radiate a portion of the absorbed energy as red shifted fluorescence. The addition of rhodamine dyes can be used where direct fuel fluorescence cannot distinguish between fuel types. We have shown that this absorption/fluorescence process produces signals that are strong enough to be easily detectable for sand coated with JP-5.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CENTER
ANDOVER, MA 01810
Phone: (508) 589-0003
Topic#: 93-176 ID#: 93WL0-175
Office: WL0
Contract #: F08630-93-C-0045
PI: William J. Marinelli
Title: Imaging Fabry-Perot Infrared Spectroradiometer
Abstract: Physical Sciences Inc. (PSI) proposes to demonstrate the application and enhance the spectral range of a novel, infrared, spectral imager based on its; demonstrated infrared, imaging, Fabry-Perot interferometer concept. The system permits real-time spectral and spatial analysis of tactical battlefield scenes and aircraft signatures. The common pixel registry afforded by the design permits unique spectral information to be extracted from cluttered background and target analysis with sub-pixel spatial resolution. The application effort will address the use of the proven characteristics of the system in the 3 to 5 and 8 to 12 Hm spectral ranges to the signatures extant in tactical battlefield and aircraft scenes, including cruise missile detection. A laboratory effort will address the issues involved in adapting the instrument concept for use in the 1 to 3 Hm range and to shorter wavelengths. Instrumental configurations are presented that cover both the atmospheric windows at 3 to 5 and 8 to 12 Hm. Illustrative estimates of the achievable noise equivalent temperature change (NEAT) of the instrument are presented.

PRINCETON ELECTRONIC SYSTEMS, INC.
11 GLENGARRY WAY
CRANBURY, NJ 08512
Phone: (609) 275-0070
Topic#: 93-067 ID#: 93PL1-234
Office: PL1
Contract #: F29601-93-C-0189
PI: CHUNI GHOSH
Title: Development of Radiation Hard Silicon Charge-coupled Devices
Abstract: Improvement of radiation hardness of CCDs for space applications is extremely important for extending the life of the CCDs. For low orbit satellites the proton damage is most important which reduces the Charge Transfer Efficiency (CTE) and increases the noise of the devices. Charge particles create displacement damage in the silicon lattice which in turn form

(112)

phosphorous-vacancy (P-V) complex which acts as electron traps. Formation of the trapping centers need to be better understood for designing radiation performance CCDs in the future. By using the software package called Transport of Radiation in Matter (TRIM), we will analyze the formation of defects and defect complexes in the device structures for the CCD devices. Particular attention will be paid to the formation of vacancy complexes by protons and other charged particles. After studying the trap formation process theoretically, we will experimentally verify them by using the accelerator at Harvard University. After we have a good model for the trap formation, we will design device structures as well as plan experiments which will be implemented during Phase II leading to extremely high performance devices for rad hard applications. These devices can be used both for military and commercial space applications.

PRINCETON SCIENTIFIC INSTRUMENTS, INC.
7 DEER PARK DRIVE
MONMOUTH JUNCTION, NJ 08852
Phone: (908) 274-0774
Topic#: 93-101 ID#: 93PL4-061
Office: PL4
Contract #: F19628-93-C-0068
PI: J.L. Lowrance
Title: High Resolution Ultraviolet Sensor
Abstract: High resolution image sensors, sensitive in the near to mid ultraviolet, and suitable for use in space are needed to improve the ability to detect and track objects in space. Such image sensors would also find use in atmospheric pollution measurements and ground based imaging of ionospheric phenomena against the sky background. The ultraviolet sensitive image sensors currently employed for these applications are limited in spatial resolution and sensitivity, dominated by the detective quantum efficiency and spatial frequency response of the image intensifier tubes employed in most of these imaging systems. The proposed study will investigate ultraviolet image sensor concepts that afford the prospect of higher spatial resolution and higher detective quantum efficiency, keeping in mind both space missions and ground based applications that would lead to commercialization.

PRINCETON SCIENTIFIC INSTRUMENTS, INC.
7 DEEP PARK DRIVE
MONMOUTH JUNCTION, NJ 08852
Phone (908) 274-0774
Topic#: 93-127 ID#: 93WL4-064
Office: WL4
Contract #: F33615-93-C-3001
PI: J. L. Lowrance
Title: High Frequency Hypersonic Fluid Diagnostics
Abstract: This proposal is for the development of a instrumentation suitable for measuring time-resolved thermodynamic or velocity fluctuations in hypersonic wind tunnel flow. A very high frame rate television type solid state camera capable of capturing images of transient photometric phenomena at framing rates up to ~1,000,000 frames per second currently under development is proposed. In Phase I the conceptual design of a diagnostic instrument based on this type of high framing rate solid state image sensor will be carried out, including parametric studies and feasibility calculations. In Phase II the camera system will be built, installed and demonstrated at Wright Laboratory.

PROTOS TECHNOLOGY, INC.
2623 BOBWHITE DRIVE
ROANOKE, VA 24018
Phone: (703) 989-2024
Topic#: 93-156 ID#: 93WL6-027
Office: WL6
Contract #: F33615-93-C-2312
PI: DR VICTOR IANNELLO
Title: A Novel Digital Controller for Magnetic Bearing Systems in Next Generation Turbine Engines
Abstract: Protos Technology proposes to develop a novel digital controller for a flight-weight magnetic bearing system for future integration with a man-rated turbojet engine. The digital controller includes an innovative technique for sensing shaft position that permits a reduction in size and complexity, improved performance, and higher reliability. Other advanced features of the controller include redundant and fault-tolerant control trains, advanced control algorithms, and miniaturization of the electronic circuitry. In Phase I, the advanced digital controller will be designed and analyzed. The performance of the sensing system will also be demonstrated experimentally. In Phase II, a prototypical digital controller will be designed, assembled, and tested in a full-scale rotor support system for a man-rated engine. In Phase III, the digital controller will be commercialized for aircraft, shipboard, and industrial engines incorporating magnetic bearings.

Q-DOT, INC.
1069 ELKTON DRIVE
COLORADO SPRINGS, CO 98090
Phone: (719) 590-1112
Topic#: 93-061 ID#: 93PL1-305
Office: PL1
Contract #: F29601-93-C-0080
PI: THOMAS E. LINNENBRINK
Title: Ultra-low-power, Charge-mode Digital Processors (Q_DOT Research Proposal 1349)
Abstract: Q-DOT proposes to develop ultra-low-power charge-mode digital processors for use in advanced packaging technologies. Initial estimates project a reduction factor of 10 to 30 in power dissipation when state-of-the-art CMOS is replaced with advanced, charge-mode logic. For example, a 32-bit serial shift built with 1um design rules and operating at 200 MHz and 5V power will dissipate 5 mW in charge mode logic and 180 mW in CMOS. While the 36:1 factor can not be maintained in more complex functions, a 10:1 ratio appears to be feasible. During Phase I, meaningful processor architectures will be developed in charge-mode logic. Their performance will be simulated. In Phase II proof-of-concept processor elements will be built.

Q.R.D.C., INC.
PO BOX 562
EXCELSIOR, MN 55331
Phone: (612) 470-6964
Topic#: 93-163 ID#: 93XRX-040
Office: XRX
Contract #: F33657-93-C-2358
PI: Dr. Daryoush Allaei
Title: A Mathematical Model to Optimize and Predict Service-free Life of Fasteners
Abstract: Unpredicted fastener failure could result in reduction (or loss) of performance and unexpected destruction of vehicles. In particular, this problem is more severe in structures subjected to high speeds such as fighter aircraft. The goal of this SBIR project is to combine the recent developments in the fields of vibrations and modeling in order to increase service-free life and the quality of performance and reliability of the fasteners, and to reduce unnecessary maintenance and failures in aircraft structures. In this Phase I project, the feasibility of developing an efficient and effective mathematical model which is capable of incorporating the dynamic characteristics of fasteners, their interfaces with the host structure, and the host structure itself will be investigated. Such combination will result in a significant gain in computational speed and improvement in accuracy of the numerical results which produce a better prediction. The model will be adaptive based on the closed-loop dynamic relation between fasteners and the host structure. The main innovations of our approach is the inclusion of the effect of fasteners on vibration phenomenons such as loci veering and mode localization and the application of the reception method to the fasteners dynamics which makes the model compatible with the existing computer models.

QUANTUM MAGNETICS, INC.
11578 SORRENTO VALLEY ROAD, SUITE 30
SAN DIEGO, CA 92121
Phone: (619) 481-4015
Topic#: 93-022 ID#: 93AFO-043
Office: AFOSR
Contract #: FQ8671-9301340
PI: Dr A.D. Hibbs
Title: A Practical HTS SQUID Magnetometry System for NDI of Aircraft
Abstract: Recent, unpublished advances in SQUID magnetometry by the proposers have removed the obstacles currently preventing practical use of the HTS SQUIDs, namely the need for HTS pickup coils and the unfeasibility of unshielded operation of HTS SQUIDs in high noise environments. As a result, a portable, compact HTS SQUID magnetometer system for NDI of subsurface structural defects in the metallic skin of aircraft is now possible. The system will be cooled by a small-scale cryocooler which will allow it to be oriented in any direction. In Phase I, Quantum Magnetics, in collaboration with the University of Maryland and IBM Research, will design an HTS SQUID magnetometry system specifically for aircraft NDI. The specifications to be met will be determined in consultation with the Air Force Logistics Command, the Air Force NDI Program Office, McDonnell-Douglas, Hercules Aerospace and other government and commercial organizations, as appropriate. In Phase II, the system will be built and tested on standard defect structures and on Air Force equipment.

QUANTUM MAGNETICS, INC.
11578 SORRENTO VALLEY ROAD, SUITE 30
SAN DIEGO, CA 92121
Phone: (619) 481-4015
Topic#: 93-023 ID#: 93AL -063
Office: AL
Contract #: F41624-93-C-2000
PI: Dr S Kumar
Title: Vestibular Magnetism: A Non-invasive Probe of the Organ of Balance

Abstract: The human balance mechanism plays an important role in the performance of Air Force personnel in flight operations. Research is needed to better understand and predict the susceptibility of individuals to flight related balance and motion disorders. Existing balance tests, based solely on the observation of reflex responses, are difficult to quantify and rely on stimuli that are usually much greater than those involved in normal function. Moreover, in many instances, they do not distinguish disorders in the central nervous system from those in the vestibular apparatus itself. Recent experiments suggest that superconducting magnetometers, or SQUIDs, can detect magnetic signals from the organ of balance. Such measurements may probe vestibular function directly, without complicating effects from the central nervous system. The magnetic signals may also provide a quantitative measure of vestibular response over the full range of stimuli. Such information is potentially useful in basic research, and may ultimately be used in the training and selection process of Air Force personnel. During Phase I, we propose to verify that the observed magnetic effects actually arise from the organ of balance. In Phase II, we will develop new instrumentation and demonstrate the potential of this new technique for application in research, clinical diagnosis, and air and space flight.

QUEST INTEGRATED, INC.
21414 68TH AVENUE SOUTH
KENT, WA 98032
Phone: (206) 872-9500

Topic#: 93-003 ID#: 93AED-035
Office: AEDC
Contract #: F40600-93-C-0006
PI: Dr. Robert W. McCullough

Title: Infrared Viewer for Turbine Engine Internal Surfaces

Abstract: The development of an instrument for mapping the infrared radiance field from interior surfaces of turbine engine exhaust cavities is proposed. The instrument will consist of a cooled, rotating optical head that will traverse along the axis of the engine exhaust, mapping the infrared radiance from the surface in 2-square-centimeter spatial resolution elements over a wavelength range of 2.5 to 14 microns. The device will be ruggedized and deployable so that its utility will not be limited to engine test cells but could also be used in the field. In order to accommodate the requirements for survivability and accuracy in a harsh environment, the infrared sensor head will be remote from the optical probe and connected by an optical relay system. The optical head will utilize a film-cooled window to provide an adequate signal-to-noise ratio. Along the optical path, the internal optical cavities will be cooled using water jackets to ensure an adequate signal-to-noise ratio. This instrument should provide a capability of taking rapid (under 60 seconds) scans of the internal radiance field inside jet-engine exhaust cavities.

QUEST INTEGRATED, INC.
21414-68TH AVENUE SOUTH
KENT, WA 98032
Phone: (206) 872-9500

Topic#: 93-006 ID#: 93AED-062
Office: AEDC
Contract #: F40600-93-C-0012
PI: Dr. Alan C. Mueller

Title: An Investigation of Balloting of Projectiles Launched From a Two-stage Light-gas Gun

Abstract: Projectiles launched at hypervelocities at the ballistic ranges of Arnold Engineering Development Center are subject to extreme loads of over 100,00 g's and occasionally fail. The ultimate material strength, in practice, limits the maximum speed to which the projectile can be launched and still remain intact. It is thought projectiles ballot, or rock back and forth, within the bore and that this could be a source of projectile failure. Balloting is a little understood dynamic, and many potential mechanisms may be responsible for this pitching motion. A more thorough understanding of the dynamics of projectile balloting could lead to improved projectile designs and operational procedures to reduce the possibility of model failure without degrading the overall performance of the gas gun. This proposal addresses the need for an analytical tool to explore the nature of balloting. Under Phase I, a simple conceptual model will be developed to investigate a broad range of potential mechanisms, including barrel misalignment, side wall friction, unbalanced axial pressure loads, and unbalanced-load pressure loads. Mechanisms identified as likely candidates for balloting will then be further analyzed using two- and three-dimensional finite elements to assess the magnitude of the balloting-induced stresses. Finally, two concepts for experiments will be studied: a laser-based angle sensor to measure in situ projectile balloting and a shock tube experiment to measure aerodynamic moments on a fixed body within the tube. Numerical simulations and experimental studies will be conducted in Phase II, and the actual prediction system, including hardware and software, will be developed.

RADIAN TECHNOLOGY, INC.
4211 BURTON DRIVE
SANTA CLARA, CA 95054
Phone: (408) 980-9877
Topic#: 93-112 ID#: 93WL2-059
Office: WL2
Contract #: F33615-93-C-1278
PI: Bill Ress
Title: High Performance, Economical Frequency Synthesizer
Abstract: OBJECTIVE: Develop and demonstrate a microwave (0.5-20 GHz) frequency synthesizer design with improved performance and low cost. EFFORT: The design will be based on what we call "parallel signal processing synthesis" (PSPS). This concept uses a Digital Synthesizer (DDS), direct synthesis step synthesizers, high speed phase-locked loops and very fast voltage controlled oscillators (VCOs) operating at the desired output frequency. The overall design will be analyzed and performance specifications will be generated for each module. The performance levels of some of the modules is well known. For example, the VCOs that have been designed for our standard product line can be tuned to a frequency within 100 ns. A bread board of the other "key" modules, whose actual performance hasn't been previously evaluated, will be built and tested. Module data, from analysis or functional testing, will be generated for each module. This information will be used in the overall analysis of the synthesizer and complete phase I of this program.

RADIX TECHNOLOGIES, INC.
329 N. BERNARDO AVE
MOUNTAIN VIEW, CA 94043
Phone: (415) 988-4700
Topic#: 93-106 ID#: 93PL6-011
Office: PL6
Contract #: F04704-93-C-0012
PI: Russell K. Johnson
Title: Interference Cancellation and Excision for Ordnance Guidance (ICE-FOG)
Abstract: This proposal presents a new technique for the nearly instantaneous removal of exceptionally strong interference from Global Positioning System (GPS) satellite signals, allowing precise navigation and trajectory estimation in high jamming environments often encountered in hostile environments. The technique beamforms on the narrowband post-despread GPS signal. The narrow bandwidth of the post-despread signal allows low processor update rates and commensurate savings in the processor's complexity, A/D converter speed (only 132 KHz required), A/D converter dynamic range, system cost and size. Extremely high platform rotation (1000/second) rates are tolerated by allowing extra degrees of freedom in the beamformer to account for signal aperture smearing (the aperture now lies in a plane as opposed to a line). The processor measures interference and SOI power present in a 1KHz despread bandwidth allowing 1KHz weight update rates even with fast or agile pulsed jammers impinging on the array pre-despread. The beamformer simply removes that portion of the pulsed jammer which remains post-despread within the 1KHz bandwidth. The beamformer adaption time is effectively instantaneous if a one millisecond digital latency delay is added to the system. The technique converges to the theoretical maximum obtainable SINR for a given jammer/satellite geometry.

RADIX TECHNOLOGIES, INC.
329 N. BERNARDO AVE
MOUNTAIN VIEW, CA 94043
Phone: (415) 988-4707
Topic#: 93-107 ID#: 93WL2-032
Office: WL2
Contract #: F33615-93-C-1268
PI: Brian Agee
Title: Full-duples LPI/AJ Communications Using Blindly-adapted Retrodirective Antenna Arrays
Abstract: An SBIR project is proposed here to develop novel techniques for directive and retrodirective LPI/AJ communications, by using blind adaptation algorithms to adjust the array weights on the receive and transmit paths of a communication system. The proposed processor has the capability to automatically extract signals from the received environment, and to transmit signals back to the signal source using an antenna pattern that is either maximally directed towards the communication source (A/J mode), or directed towards the communicator and away from the other emitters in the environment (LPI mode). The processor can accomplish this adaptation without special-purpose antennas, special sensor geometries, or receiver calibration data to set the reception or transmission arrays. The processor is specifically designed to be used in conjunction with LPI (pseudonoise DS and hybrid FH/DS) modulation formats. The objective of this SBIR project is to demonstrate the utility of blind directive/retrodirective communications for a full-duplex air-to-air/ground communication link. The technique development and evaluation will determine the performance of the system configurations under realistic conditions, using computer simulations. The evaluation will also include an assessment of the cost and performance trade-offs in the overall system, with emphasis on minimizing cost at the ground site.

RADIX TECHNOLOGIES, INC.
329 N. BERNARDO AVE
MOUNTAIN VIEW, CA 94043
Phone: (415) 988-4700

Topic#: 93-164
Office: WL0
Contract #: F08630-93-C-0024
PI: Russell K. Johnson

ID#: 93WL0-045

Title: Interference Cancellation and Excision for Ordnance Guidance (ICE-FOG)

Abstract: This proposal presents a new technique for the nearly instantaneous removal of exceptionally strong interference from Global Positioning System (GPS) satellite signals, allowing precise navigation and trajectory estimation in high jamming environments often encountered in hostile environments. The technique beamforms on the narrowband post-despread GPS signal. The narrow bandwidth of the post-despread signal allows low processor update rates and commensurate savings in the processor's complexity, A/D converter speed (only 132 KHz required), A/D converter dynamic range, system cost and size. Extremely high platform rotation (1000/second) rates are tolerated by allowing extra degrees of freedom in the beamformer to account for signal aperture smearing (the aperture now lies in a plane as opposed to a line). The processor measures interference and SOI power present in an 1 KHz despread bandwidth allowing 1 KHz weight update rates even with fast or agile pulsed jammers impinging on the array pre-despread. The beamformer simply removes that portion of the pulsed jammer which remains post-despread within the 1 KHz bandwidth. The beamformer adaption time is effectively instantaneous if a one milli-second digital latency delay is added to the system. The technique converges to the theoretical maximum obtainable SINR for a given jammer/satellite geometry.

RAMAR CORP.
P.O. BOX 835, 270 LITTLETON RD., UNIT #27
WESTFORD, MA 01886
Phone: (508) 392-0952

Topic#: 93-088
Office: PL1
Contract #: F29601-93-C-0051
PI: AMARESH MAHAPATRA

ID#: 93PL1-058

Title: USAF - Phillips Laboratory; Technology Transfer Passive Wideband Electromagnetic Field Sensor

Abstract: We propose the use of a Fabry-Perot resonator using channel waveguides in lithium niobate for use as an electromagnetic field sensor. The length of the resonator will be 1 to 3 mm with a finesse of 100 or higher. This large finesse will make the effective Vpi about 0.1 volts while using short, low capacitance electrodes. As a result bandwidths will exceed 10 GHz. In addition we will fabricate a reference resonator on the same substrate without electrodes to discriminate against temperature and wavelength fluctuations. In Phase I we will fabricate multiple resonators on the same substrate with metallic mirrors. RAMAR has, in the past, fabricated such resonators with a finesse of 40. We will measure the bandwidth and voltage sensitivity. We will evaluate the similarity of resonators on a single substrate for using one as a reference. RAMAR is a four year old company devoted exclusively to the design, manufacture, and marketing of lithium niobated modulators for the communications, CATV and sensor industry. We are involved with the complex packaging issues for these devices and are well positioned to cooperate with Phillips Laboratory to commercialize this technology.

RETICULAR SYSTEMS, INC.
6265 GREENWICH DRIVE, STE 201
SAN DIEGO, CA 92122
Phone: (619) 457-0709

Topic#: 93-071
Office: PL1
Contract #: F29601-93-C-0098
PI: Dan R. Ballard

ID#: 93PL1-257

Title: Intelligent Agent Technology for Spacecraft Reprogrammability

Abstract: The purpose of this research effort is to develop techniques and methodologies required for remote reprogramming of intelligent spacecraft systems that do not require expensive up-link bandwidth or communications connection time, and be usable with systems using MIL-STD-1750A processors. Reticular Systems, Inc., is proposing to investigate the application of intelligent agent technology, an area of distributed artificial intelligence which builds networks of communicating and cooperating agents that address the difficulties of complex systems that must solve problems using limited communications bandwidth. Reticular Systems, Inc., proposes the use of an intelligent agent that will handle the reprogramming workload aboard the spacecraft or satellite. This agent is specifically designed to handle the problems involved in on-board spacecraft reprogramming. The agent will handle communications with the ground and intelligently modify the code of the on-board expert system. A ground-based reprogramming agent will be used in developed software changes and updates. Reticular Systems, Inc., proposes to implement the reprogramming techniques and technologies in a small prototype system similar to systems found aboard spacecraft and satellites, using a prototypical expert system to verify the reprogramming techniques, and develop figures of merit.

RGB ASSOC., INC.
16 ROLLING LN., P.O.BOX 8
WAYLAND, MA 01778
Phone: (617) 627-3136

Topic#: 93-081 ID#: 93PL1-297
Office: PL1
Contract #: F29601-93-C-0063
PI: RICHARD BARAKAT

Title: Thick Aberrator Compensation in Post-detection Image Correction

Abstract: The main theme of the Phase I effort will be to attempt to answer the basic question: What is the amount of detail (or resolution) that can be recovered from the degraded signal (i.e., diffraction image) given partial knowledge of the turbulence indices spatially random wavefront Ws? In order to answer this basic question, we propose a three-pronged attack: (1) development of methods in the context of wave propagation to predict the variance and correlation function of wavefront propagation in a turbulent atmosphere for both vertical up-look and horizontal look sight paths; (2) reprogram the Barakat/Beletic algorithm for generating sample realizations of diffraction functions using information from item (1) and further develop the algorithm to include sample realizations of extended objects; and (3) institute investigation of efficacy of various post-detection image restoration techniques and test them using the above algorithm.

ROCKFORD TECHNOLOGY ASSOC., INC.
912 WEST ARMORY
CHAMPAIGN, IL 61821
Phone: (217) 333-3772

Topic#: 93-093 ID#: 93PL3-030
Office: PL3
Contract #: FO4611-93-C-0084
PI: Jalal Javendani

Title: Critical Technology Demonstration Plasma Focus Type MPD Thruster

Abstract: This project involves a study with a gas-injected plasma focus facility intended to develop the database to design and build an optimized 1-MJ focus. The ultimate objective is to demonstrate the feasibility and attractiveness of this concept for very high specific impulse space propulsion. Studies include scaling experiments with an existing 10-kJ device and construction of a prototype 250-kJ module representing one of four such modules for this 1-MJ facility. The focus concept employs jxB plasma acceleration to generate thrust in a manner similar to the conventional Magneto Plasma Dynamic (MPD) thruster. However, the focus has the added advantage of generating additional thrust from fusion energy released during the pinch phase of the arc rundown. Experiments proposed include studies of electrode dimensional effects, variation of performance with outer electrode flow passage size, and alternate gas injection points. The prototype module will be used to study optimum power generation and transfer to the thruster electrodes. The data will provide a parametric basis for optimizing thrust generation and for the scale-up to larger energy devices. This will enable the design of an optimized 1-MJ facility planned for Phase II of the study.

ROSE IMAGING
1358 CHESTERFIELD ESTATES DR.
CHESTERFIELD, MO 63005
Phone: (314) 532-3126

Topic#: 93-023 ID#: 93AL -152
Office: AL
Contract #: F41624-93-C-6007
PI: Gulab Bhatia

Title: Whole Body Surface Scanner for Design of Protective Equipment

Abstract: We propose to design, implement and test the feasibility of a full body surface digitizing system to be used for anthropometric studies and design of protective equipment. Resolution, speed, coverage and accuracy of three dimensional (3D) optical surface scanning will be defined. A generic whole body scanner will be designed, and a software simulation system will be implemented and used to test the design and to evaluate alternative system configurations. We propose to develop and test our technique based on a non-contact, optical, multi-sensor range scanning technique that digitizes the entire surface in less than one second. This device employs "white light" pattern projectors and employs no harmful ionizing radiation. This approach allows the digitization of complex surfaces with the use of appropriate sensor (digital cameras and light beam projectors) configuration. Multi-resolution data, depending on the requirement, can be collected for different surfaces simultaneously or separately and integrated together to provide one comprehensive data set describing the body surface. The expense of collecting anthropometric methods used presently. 3D surface data of the human body will provide accurate anthropometric measurements useful in the design and evaluation of advanced aircraft and modern personal protective equipment systems.

S.T. RESEARCH CORP.
8419 TERMINAL ROAD
NEWINGTON, VA 22122
Phone: (703) 550-7000

Topic#: 93-112
Office: WL2
Contract #: F33615-93-C-1269
PI: Randolph Moore

ID#: 93WL2-063

Title: Development and Demonstration of a Microwave Frequency Synthesizer Design with Improved Performance and Low Cost

Abstract: The proposed technique, Direct RF Generation, has been validated in architectures providing extremely efficient implementation of high performance synthesizers, with very fast turning speeds, high frequency accuracies, low phase noise and pulse-to-pulse coherence. The proposed system will be competitive with the best laboratory equipment, even that most recently available. To meet other, less stringent Air Force requirements, the Direct RF Generation architecture could be tailored to provide a broad range of tuning bandwidths, settling times, frequency accuracies and spectral purities. By using direct microwave RF generation controlled by a fast, very broadband Phase-Lock Loop (PLL), the system avoids the hardware intensive filtering techniques necessary in traditional up-conversion and multiplication schemes and will employ readily available commercial hardware, providing extremely attractive size and cost efficiencies. The proposed system also avoids the phase noise problems of DDS's. The proposed Phase I SBIR program will present the results of laboratory breadboard experimentation; will provide a specific high performance, affordable design for Phase II development and demonstration, with performance, size and production cost estimates; and will offer a proposed Phase II SBIR hardware development and demonstration program plan.

SADDLEBACK AEROSPACE
24000 ALICIA PARKWAY, NO. 17-428
MISSION VIEJO, CA 92691
Phone: (714) 582-8878

Topic#: 93-086
Office: PL1
Contract #: F29601-93-C-0039
PI: GEOFFREY O. CAMPBELL

ID#: 93PL1-319

Title: Semiconductor Laser Array Cooler Development

Abstract: Semiconductor laser diode arrays are encountering performance limitations due to the inability to remove high levels of waste heat. Previous studies have examined the use of microchannel cooling devices to address this problem, but the performance of these devices has been limited by fabrication constraints. Saddleback Aerospace is proposing an alternative microchannel fabrication approach, which results in a doubling of the heat dissipation capability compared to previous work, and provides a much more robust microchannel structure. In this effort, analytical trade studies will be performed, and two prototype semiconductor laser array coolers will be fabricated. The thermal and flow performance of the coolers will be evaluated in laboratory testing. The result will be a sound analytic and experimental basis for the near-term development of practical semiconductor laser array coolers.

SANDIA SYSTEMS, INC.
2655A PAN AMERICAN FREEWAY NE
ALBUQUERQUE, NM 87107
Phone: (505) 343-8112

Topic#: 93-119
Office: WL3
Contract #: F33615-93-C-1251
PI: Richard Krukar

ID#: 93WL3-041

Title: Automated Defect Analysis Using a Dome Scatterometer and Image Analysis

Abstract: We will model the optical scatter produced by different shapes and concentrations of defects using scalar diffraction theory. We will develop image processing techniques which can be used to supply features to analysis routines using the model data and determine the ability of the technique to predict the shape and concentration of defects. We will assemble a dome scatterometer, examine samples of material which have defects similar in shape and density as those which have been modeled, and determine the ability of the image processing techniques to predict defect properties using real samples. Based on the level of success achieved, we will determine modifications necessary for the image processing and analysis techniques and for the dome scatterometer. These changes and an improved dome scatterometer will be implemented in a Phase I effort.

SAPHIKON, INC.
33 POWERS STREET
MILFORD, NH 03055
Phone: (603) 673-5831

Topic#: 93-137
Office: WL5
Contract #: F33615-93-C-5333
PI: Herbert E Bates

ID#: 93WL5-131

Title: Continuous Mullite Fibers for High Temperature Structural Ceramic Composites

Abstract: The Phase I project will demonstrate the feasibility of producing Mullite (Al6Si2O13) fibers using the Saphikon Edge-defined, Film-fed Growth (EFG) process. The reactivity of mullite melts ranging from 60 to 80 mole percent will be evaluated using crystal growth components fabricated from iridium, and components with a coating of iridium. Fibers will be grown under a range of conditions and evaluated to determine tensile strength at room and elevated (2400 F) temperature. Fiber microstructure will be identified, and comparisons made after extended 2400 F exposure in air. Specimen quantities of fiber will be characterized and made available for Air Force evaluation.

SCHAEFFER INDUSTRIES
2421 WEST PRATT BLVD., M/S 445
CHICAGO, IL 60645
Phone: (312) 509-8095
Topic#: 93-094 ID#: 93PL3-060
Office: PL3
Contract #: FO4700-93-C-0089
PI: Richard Badke
Title: High-temperature Arcjet Insulators
Abstract: An important component of arcjet thrusters is the insulator holding the cathode base and separating the electrodes. The current baseline material is Boron Nitride (BN), which is well known for its high electrical resistivity and high thermal conductivity. However, at arcjet operating temperatures, BN has a dramatic increase in electrical conductivity and a decrease in thermal conductivity. Additionally, the vapor pressure of BN becomes appreciable above 2000C. A new composite insulating material will be investigated in the proposed program. This material will have a tailorable thermal conductivity, low vapor pressure and high electrical resistivity with an operating range up to 3100C.

SCHAEFFER INDUSTRIES
2421 WEST PRATT BLVD., M/S 445
CHICAGO, IL 60645
Phone: (312) 509-8095
Topic#: 93-096 ID#: 93PL3-061
Office: PL3
Contract #: FO4700-93-C-0094
PI: Richard Badke
Title: High Emissivity Coatings for Arcjet Thrusters
Abstract: The addition of a high emissivity coating to the radiating surfaces of an arcjet thruster has been explored as a means to improve arcjet performance. At arcjet nozzle operating temperatures, the emissivity of an uncoated tungsten nozzle is approximately 0.4. When coated with a material having an emissivity of 0.55-0.6, the nozzle temperature is reduced by 120C, due to enhanced radiative cooling. The proposed program will investigate potential emissivity coating with radiation coefficients up to 0.8-0.9. The use of such coatings can reduce nozzle operating temperatures, leading to longer anode life. Enhanced radiative cooling will also provide wider engine design lattitude and improved operating power margins.

SCIENCE & APPLIED TECHNOLOGY, INC.
6540 LUSK BLVD, SUITE C-250
SAN DIEGO, CA 92121
Phone: (619) 453-6544
Topic#: 93-170 ID#: 93WL0-136
Office: WL0
Contract #: F08630-93-C-0055
PI: Charles F. Human on behal
Title: Low Cost Aerodynamic Control Surfaces for Compressed Weapon Carriage
Abstract: This program provides an approach to identify and evaluate innovative concepts of low cost aerodynamic control surfaces for compressed weapon carriage for both air-to-surface and air-to-air weapon system. In the early stages of the program we will assess the dynamic environment and develop a set of goals/requirements for subsonic and supersonic compressed weapon carriage systems. The goal is a compact configuration where many low drag stores can be carried within a volume constrained weapons bay, on pylon mountings, or housed within a low profile under wing conformal pod. Trade off analyses will be performed on analyzing and defining the folding mechanism design for control surfaces and fixed wings and surveying the types of materials best suited for each design. Preliminary studies have shown that potential folding mechanism concepts exist which not only satisfy the requirements for compressed volume carriage, but also offer substantial potential missile performance improvements in terms of standoff range and terminal accuracy. These potential system level performance improvements will be a consideration during the conceptual trade studies, in addition to the folding mechanism design requirements. The final result will be a preliminary design for both fixed and control surfaces for subsonic and supersonic compressed weapon carriage systems providing extremely low parasitic drag performance.

SCIENCE & ENGINEERING ASSOC., INC.
SEA PLAZA, 6100 UPTOWN BLVD, NE, SUITE 700
ALBUQUERQUE, NM 87110
Phone: (505) 884-2300
Topic#: 93-026 ID#: 93AL -185
Office: AL
Contract #: F41624-93-C-9013
PI: Brian Kohn
Title: Communicating Via the Microwave Auditory Effect
Abstract: In this research program, we plan to investigate a revolutionary new form of communication based on the microwave auditory effect. This proposed communication idea satisfies the requirements for an innovative, natural interface requiring no learning or training for efficient operation and effective communications. The purpose of the program proposed here is to extend the results of a recent feasibility study, performed for the Armstrong Laboratory/OEDR. The study found that voice communications, via the microwave auditory effect, are highly feasible. In Phase I of this SBIR, we propose to investigate the range of potential applications for this radically different form of voice communication and recommend hardware and systems concepts suitable for laboratory and brassboard demonstrations to be built under Phase II.

SCIENCE & ENGINEERING ASSOC., INC.
SEA PLAZA, 6100 UPTOWN BLVD, NE, SUITE 700
ALBUQUERQUE, NM 87110
Phone: (505) 884-2300
Topic#: 93-077 ID#: 93PL1-119
Office: PL1
Contract #: F29601-93-C-0048
PI: ROBERT FISHER
Title: Development of a Microwave Integrated Fields and Circuit Coupling Code
Abstract: Quality computational tools have been available for solving exterior electromagnetic coupling problems and for solving circuit problems for many years. The desire to extend this conventional analysis to the solution of interior coupling problems with internal circuitry is the principle focus of the work proposed here. The component technology elements required to integrate the EM analysis of coupling to cavities with circuits are already available. What is proposed here is the integration of the disparate analysis techniques and algorithms into one easy to operate and apply analysis tool. We propose to accomplish this through the judicious selection on new and available technology which will form the core program elements of the new integrated code. A user friendly operating shell will then be developed which will allow the analyst to easily specify the parameters of a problem and command solution and analysis of the problem through simple on-screen menu selections. The resulting integrated fields and circuits coupling code will be designed as a thoroughly modular program, making the later addition of new features straight-forward.

SCIENCE & ENGINEERING ASSOC., INC.
3838 CAMINO DEL RIO NORTH
SAN DIEGO, CA 92108
Phone: (619) 284-0189
Topic#: 93-178 ID#: 93WL0-210
Office: WL0
Contract #: F08630-93-C-0080
PI: Dr. Steven J. Saggese
Title: Fiber Optic System for the Delivery of High Power Laser Radiation
Abstract: A Mobile Ordnance Disrupter System (MODS), which is being developed for Explosive Ordnance Disposal (EOD), utilizes a high power Nd:YAG laser for munitions neutralization. This concept allows for EOD at a safe distance, which minimizes the risk to personnel. A shortcoming of the MODS is the inability to neutralize munitions that are out of the line-of-sight. An optical fiber waveguide can be exploited to transfer the laser energy to non-line-of-sight locations thus improving the efficiency of the MODS along with enhancing the safety of the operators. SEA will demonstrate the delivery of high power Nd:YAG energy through a long length of optical fiber to show the feasibility of such a system. The eventual system, however, must be able to deliver high powers, be able to withstand the rigors of field deployment, and be disposable due to the catastrophic nature of the neutralization method. To achieve this ultimate task, SEA has developed a simple, inexpensive, expendable cable design which combines the power delivery fiber optic waveguide, an illumination waveguide, and a visualization system into one unit. The design incorporates the Fiber Optic Microcable (FOMC), developed by the Navy, which utilizes state-of-the-art coating technology to fortify the optical cable.

SCIENCE RESEARCH LABORATORY, INC.
15 WARD STREET
SOMERVILLE, MA 02143
Phone: (617) 547-1122
Topic#: 93-011 ID#: 93AFC-170
Office: AFCESA
Contract #: F08635-93-C-0092
PI: DR ALLEN FLUSBERG

Title: Ultrasensitive Interferometric Detection of Launch Vehicle Pollutants
Abstract: The 1990 Clean Air Act Amendments list nearly two hundred toxic materials that must be regulated. Among these are hydrazines, compounds that are used as rocket fuels. Air Force compliance with Environmental Protection Agency (EPA) regulations will dictate the investigation and careful monitoring of the emissions of hydrazines to the atmosphere, particularly during the fueling and launching of rocket vehicles. However, current techniques to monitor atmospheric pollutants are not sensitive and specific enough to hydrazines to satisfy future EPA requirements. To fill this need, Science Research Laboratory (SRL) proposes to develop a portable interferometric pollution monitor (IPM) with the capability of measuring hydrazine and other pollutants in situ and continuously at the parts-per-trillion (ppt) level. The basis of this instrument is the interferometric measurement of the optical-path change that occurs immediately after a pulsed carbon-dioxide laser beam is absorbed by the pollutant present in one arm of the interferometer. An instrument that utilizes a line-tunable, pulsed carbon-dioxide laser can be tuned through the near-infrared absorption spectrum of hydrazines to determine their concentration in the presence of other absorptive species. An IPM will be sensitive to a concentration of several parts per trillion, orders of magnitude better than instruments based on other approaches to detect such toxic species. Such an instrument will be ideal for monitoring compliance with EPA regulations and for continuous measurement of the effectiveness of control processes that minimize the emission. The proposed Phase I feasibility study will be followed by a Government-sponsored proof-of-principle Phase II demonstration.

SCIENTIFIC MATERIALS CORP.
310 ICEPOND ROAD, P.O. 786
BOZEMAN, MT 59715
Phone: (406) 585-3772
Topic#: 93-021 ID#: 93AFO-062
Office: AFOSR
Contract #: FQ8671-9301372
PI: Ralph L Hutcheson
Title: Materials for Spectral Hole Burning Research
Abstract: A program is proposed to develop a commercial source for spectral hole burning materials and their properties. The proposed program will create a file of material and their properties for this application. A crystal growth program is proposed to grow Eu:Y2Si05, Pr:YA103, and Sm:CaW04.

SCIENTIFIC STUDIES CORP.
2250 QUAIL RIDGE
PALM BEACH GARDEN, FL 33418
Phone: (407) 694-0999
Topic#: 93-035 ID#: 93ES3-220
Office: ES3
Contract #: F30602-93-C-0143
PI: Jaime R. Roman, PhD
Title: Multichannel Detection Using Higher-Order Statistics
Abstract: A model-based approach is proposed for multichannel system modeling and detection in the context of radar system applications, using higher-order statistics (HOS) for the identification of time series model parameters. The model innovations sequence is used for the detection decision. In general, HOS-based algorithms offer several advantages over conventional time series methods based on second-order statistics. Higher-order cumulants contain information about the system phase, and thus can be used to model both minimum-phase and non-minimum-phase systems. This allows a larger model class for the modeling of radar return signals. HOS-based algorithms specifically address the cases where the desired signal portion does not exhibit Gaussian statistics, which is the case in many radar system applications. Additionally, the higher-order cumulants are insensitive to additive Gaussian-distributed noise, such as receiver noise and interference sources. Thus, cumulant-based algorithms offer potential for improved performance in many radar target detection problems.

SECA, INC.
3313 BOB WALLACE AVENUE, SUITE 202
HUNTSVILLE, AL 35802
Phone: (205) 534-2008
Topic#: 93-102 ID#: 93PL4-079
Office: PL4
Contract #: F19628-93-C-0077
PI: Richard C. Famrer
Title: Heated Cloud Rise Model
Abstract: The rise of launch clouds to stabilization is forced by an altitude varying distribution of momentum and buoyancy (temperature). In most of the plume, the temperature excess over that of the atmosphere is large and the buoyant force accelerates the launch products to "high" altitudes. The acceleration is retarded by the exhaust velocity, but augmented strongly by water vapor phase changes and possibly by heat release from residual chemistry. Turbulent diffusion of the buoyancy with or without wind shear and atmospheric temperature gradients stop the flow above the neutral buoyancy level; the flow falls back

and the cloud is transported within the prevailing weather. The cloud may be toxic. We develop a first-principle computational capability centered on a proven cloud formation code (PSR/2DSALE). A tailored grid with variable vertical resolution based on specific launch profiles is proposed, and we develop a distributed buoyancy and momentum source function based on the "ground" cloud and standard plume flowfield. We plan a test calculation matrix with stable and unstable atmospheres, high and low moisture profiles, and wind shear. We add PSR's multicomponent first-principle microphysics code to account rigorously for particle growth in the plume and cloud. Extension to a Phase II 3-D capability is planned.

SEKI SYSTEMS COMPANY
1353 TROON DRIVE
WEST LINN, OR 97068
Phone: (503) 690-1155
Topic#: 93-059
Office: ES3
Contract #: F30602-93-C-0132
PI: Robert G. Babb II
ID#: 93ES3-184
Title: Real-time High Performance Visualization Tool
Abstract: The Real-time Software Visualization Tool development work that is proposed will leverage existing technology to allow rapid, safe development of real-time and parallel programs and parallelization of existing serial programs. Seki Systems proposes to add support for real-time programming to its parallel program visualization workbench, SekivieW, and improve the graphical interface of SekivieW to simplify its learning curve and use for real-time programming.

SENSORDEK, INC.
870 SUMMIT AVENUE
NILES, OH 44446
Phone: (216) 652-0156
Topic#: 93-136
Office: WL5
Contract #: F33615-93-C-5346
PI: Glen A Schaefer, PhD
ID#: 93WL5-098
Title: Mold Wall Reactions in the Directional Solidification of Gamma TiAl Alloys
Abstract: This project will utilize the modified Bridgeman technique of crystal growth for the high temperature processing of gamma TiAl alloys. It will develop and test eight distinct mold materials for their performance and product integrity. Attention will focus on the relationship between the mold wall/liquid metal interface and the quality of the cast material. The project will develop a bi-level hierarchy for testing: Level I consists of the screening of candidate mold materials and Level II continues evaluations of the top two candidates. The project will result in suggestions for application of oriented TiAl crystals for aerospace and related industries.

SENSORS UNLIMITED, INC.
3490 U.S. ROUTE 1, BLDG 8
PRINCETON, NJ 08540
Phone: (609) 520-0610
Topic#: 93-079
Office: PL1
Contract #: F29601-93-C-0057
PI: DR. GREGORY H. OLSEN
ID#: 93PL1-146
Title: Mid-infrared 2-5um Master-oscillator Power-Amplifier Lasers
Abstract: We propose to design, construct, and optimize "master-oscillator power amplifier" (MOPA) lasers for the 2-5 um mid-infrared spectrum. These devices would have high output (>100mw) and operate at or near room temperature. Our innovation is to use multiple quantum-wells in the AlGaAsSb/InGaAsSb materials systems in the design of MOPA mid-infrared semi-conductor diode lasers. In Phase I, we would develop design rules for the quantum wells and optical structures and design a complete MOPA structure for the 3.3 um emission, a key wavelength for methane gas (CH4) detection. In Phase II, we would take advantage of our ongoing materials research with expitaxial layers of AlGaAsSb and InGaAsSb and fabricate a working MOPA laser for 3.3 um. We would optimize the power output and beam quality of this device and then apply this know-how to other wavelengths for gas spectroscopy, such as 4.2 um (carbon dioxide) and 4.6 um (carbon monoxide). Dr Ray Martinelli of the SRI David Sarnoff Research Center will consult on the project.

SHIELD RITE, INC.
P.O. BOX 8250
ALBUQUERQUE, NM 87198
Phone: (505) 842-6018
Topic#: 93-077
Office: PL1
Contract #: F29601-93-C-0047
PI: RICHARD HOLLAND
ID#: 93PL1-222
Title: Integration of Maxwell-solving and Circuit Analysis Software

Abstract: Contractor will explore techniques for combining EM coupling code and circuit analysis code to determine transfer functions from fast-pulse HPM threats to circuit-component responses. Techniques must be general enough to consider pulse rise time, total energy, and duration. Treatment must be general enough to work for aircraft, sensor pods, missiles, and satellites. Coupling through antennas, sensors, leaky gaskets, and hatches must be permitted. Contractor proposes to treat the exterior coupling, the RF points of entry, the internal RF response, the internal RF coupling to cables and circuits, and the circuit response as associated, but mostly separate, problems, although the last two aspects probably require simultaneous treatment. Feasibility studies will be made for different approaches to each of these five sub-problems. At present, our inclination is that the external problem may be treated deterministically, but the internal response can only be treated statistically.

SIERRA MONOLITHICS, INC.
103 W. TORRANCE BLVD., SUITE L02
REDONDO BEACH, CA 90277
Phone: (310) 379-2005
Topic#: 93-057 ID#: 93ES3-166
Office: ES3
Contract #: F19628-93-C-0109
PI: Dr. Binneg Y. Lao
Title: Superconductive Microwave/Millimeter Wave Antenna
Abstract: A High Temperature Superconducting Rotman lens is proposed as the preferred approach to replace the standard NxN phased array antenna for a beam forming microwave/millimeter wave antenna system. The Rotman lens approach requires significantly less interconnects and at the same time offers large bandwidth and simultaneous multichannel detections. Two orthogonal planar Rotman lenses with 2N detectors provides coverage equivalent to an NxN phased array with NxN detectors. Sierra and its partner TRW are also developing GHz superconducting digital frequency synthesizers and A/D converters, which will complement the proposed antenna program as additional required modules for the final antenna system. The Phase I effort includes antenna system requirement definition, antenna design using the optimal technologies, performance predictions, and fabrication and test of an HTS Rotman lens antenna demonstration breadboard.

SIERRA MONOLITHICS, INC.
103 W. TORRANCE BLVD., SUITE 102
REDONDO BEACH, CA 90277
Phone: (310) 379-2005
Topic#: 93-113 ID#: 93WL2-067
Office: WL2
Contract #: F33615-93-C-1304
PI: Dr. Binneg Y Lao
Title: Superconducting Digital RF Memory
Abstract: Superconducting A/D converters at multi-GHz clock speeds with 4-8 bit resolution open possibilities for full simultaneous 2-20 GHz coverage DRFMs. However, high speed Superconducting memories do not offer the required density for DRFM applications. Sierra Monolithics/TRW team proposes the development of a random access memory scheme with speed and density needed for Superconducting DRFM (S-DRFM) applications. The memory proposed is a hybrid of the high speed SFQ memory and high density Cryogenic CMOS. The Superconducting SFQ circuits are used to handle incoming data from ADC, memory management, RAM sense amplifiers, and data stream reconstruction. The cryogenic CMOS circuits are used for high density memory cells, line decoders, and high voltage drivers. Thus, the speed and complexity barriers for microwave digital memory are overcome. The Phase I effort will be devoted to the architectural design and simulation of the superconducting SFQ multiplexer and demultiplexer, memory management and superconducting sense amplifiers for bit detection. The hardware demonstration of the key components will be performed in Phase II.

SIGMA LABS, INC.
10960 NORTH STALLARD PLACE
TUCSON, AZ 85737
Phone: (602) 575-8013
Topic#: 93-134 ID#: 93WL5-063
Office: WL5
Contract #: F33615-93-C-5373
PI: Angelo Yializis, PhD
Title: A New Class of Highly Oriented Stable Polymer Material for High-speed Electro-optic Waveguide Devices
Abstract: A new method is proposed for the development of stable, high speed electro-optic polymers for optical waveguide devices such as switches and couplers. Thin polymer films will be produced by a new process that we refer to as flash evaporation. The process is based on negative electron beam photoresist technology, capable of easily processing thin-film and waveguide structures on various substrates, including silicon. A new family of acrylate monomer materials containing highly non-linear chromophores will be evaporated in vacuum and poled at room temperature in the liquid state before polymerization by electron-beam cross linking. The film thickness can vary from about 500A Degrees to 5 m, and individually poled multi-

layer film structures can be constructed. We believe that this unique process is superior to any previous approach for forming EO polymers, and it will enable the fabrication of thin polymer films with a strong polar orientation, superior thermal and mechanical properties and improved aging characteristics.

SIX SIGMA ANALYTICS
401 CANYON WREN
BUDA, TX 78610
Phone: (512) 295-3650
Topic#: 93-039 ID#: 93ES2-122
Office: ES2
Contract #: F19628-93-C-0155
PI: John J. O'Connor
Title: Information Strategy Plan: In-transit Visibility of AMC Deliverables
Abstract: The DoD investment in C3 equipment would indicate that intransit data is indeed available to transportation decision makers throughout the system. But no single system can be relied upon to pinpoint the precise location of a particular cargo item, or a particular passenger. Voice relays using unreliable HF radios from the aircrew, or telephone patches from the point of embarkation are still relied upon to track a misdirected cargo item or missing passenger. AMC is re-thinking all aspects of its airlift business resulting in new emphasis on "customer satisfaction". AMC needs to track, and make available to its customers, the real time status and location of planned, intransit, and delivered cargo and passenger movements, especially in electronic form to facilitate data exchange with intermodal transportation systems. Six Sigma Analytics, Inc. proposes to investigate the force movement information requirements among the various command and control (C2) nodes within the Defense transportation shipping system. The overall objective of the Phase I effort is to design a top level information strategy plan (ISP) to provide the framework in which to consolidate force movement data and correlate AMC C2 functions with specific data requirements. This top level ISP will provide a roadmap to improve the tracking of AMC's deliverables--airlifted cargo and passengers.

SOHAR, INC.
8421 WILSHIRE BLVD SUITE 201
BEVERLY HILLS, CA 90211
Phone: (213) 653-4717
Topic#: 93-060 ID#: 93ES3-212
Office: ES3
Contract #: F30602-93-C-0134
PI: Herb Hecht
Title: Software Reliability Model for Distributed Systems
Abstract: Distributed computing has the potential of much further growth aided by current developments in the computer and communication areas, but this progress may be impeded by deficiencies in software reliability and maintainability. The software reliability modeling methodology and tool to be developed under this effort can make outstanding contributions to reducing system and software reliability problems by (a) identifying areas where deficiencies are most likely to be found; these can be functional areas (e.g., redundancy management) or software technology areas (e.g., task synchronization), (b) permitting rapid evaluation of the reliability benefits of alternative software or system configurations, (c) providing an objective basis for hardware/software trade-offs, and (d) providing an objective basis for reliability/performance trade-offs. The effort consists of (1) definition of software reliability metrics for distributed systems, (2) establishing model selection criteria, (3) model evaluation, and (4) prototyping the selected model.

SORBENT TECHNOLOGIES CORP.
1935 EAST AURORA RD
TWINSBURG, OH 44087
Phone: (216) 425-2354
Topic#: 93-011 ID#: 93AFC-065
Office: AFCESA
Contract #: FO8635-93-C-0104
PI: SIDNEY G. NELSON
Title: Controlling Combustion-source Emissions at Air Force Sites
Abstract: Selective catalytic reduction (SCR) is the most common exhaust-gas-treatment process being used today to control NOx from stationary combustion units. However, SCR has some disadvantages. For example, SCR is very expensive to install and to operate; it employs catalysts that are easily blinded; it requires ammonia additions that sometime slip through the catalyst beds; it generally performs satisfactorily only at high temperatures. Recently, Sorbtech developed for the Air Force a simple, low-cost alternative to SCR for controlling NOx in exhaust gases produced in jet-engine test cells (JETCs). The development is a two-bed filter that demonstrates attractive removals of not only NOx, but also of CO, small (P-10) particles, SO2, HC1, and other contaminants. The new filter could have many Air Force and civilian applications, in addition to JETCs. The proposed project will explore three of these potential applications (natural-gas boilers, diesel engines, and a waste incinerator)

at actual sites at McClellan AFB.

SPACE APPLICATIONS CORP.
6632 S. 191ST PLACE, SUITE E-103
KENT, WA 98032
Phone: (206) 656-0140
Topic#: 93-066 ID#: 93PL1-226
Office: PL1
Contract #: F29601-93-C-0088
PI: WILLIAM D. CARROLL

Title: Advanced Sensor Simulation and Evaluation Testbed

Abstract: Space-based remote sensing and surveillance is an important on-going mission for the Air Force. As the development of sensor technology advances, it is crucial that the tools available to the system designer are equal to the task of leveraging the monetary and human resources invested in RDT&E sensor programs. There is a need for a tool to allow the systems designer to identify critical path technologies, explore design alternatives, and to evaluate system performance. A dynamic simulation that models the sensors and the space vehicle, as well as the environment in which they operate, will ease the development workload required for the next-generation of space-based sensor systems. We are proposing a workstation-based sensor simulation testbed to provide a framework for the integration of multiple sensor simulations, a dynamic spacecraft simulation, and background scene generation. Phase I will assess the feasibility of our approach and, in so doing, provides a software and hardware architecture for an Advanced Sensor Simulation and Evaluation Testbed (ASSET). Phase II will implement a prototype ASSET and evaluate its performance.

SPACE COMPUTER CORP.
2800 OLYMPIC BLVD, SUITE 104
SANTA MONICA, CA 90404
Phone: (310) 829-7733
Topic#: 93-061 ID#: 93PL1-310
Office: PL1
Contract #: F29601-93-C-0079
PI: MICHOLAS J. TENEKETGES

Title: Ultra-low-power Digital CMOS for Multi-chip Modules

Abstract: Space Computer Corporation, in collaboration with Stanford University, proposes to reduce power dissipation in CMOS digital integrated circuits by up to two orders of magnitude. Since power dissipation constitutes a major limitation to increased circuit density in electronic systems, such reduction is mandatory if the potential of 3-d multi-chip module packaging for minimizing size, weight, and power is to be realized. Our basic approach minimizes the switching energy per operation by reducing the supply and threshold voltages from five volts to one-half volt. In order to implement this approach, which involves the use of very small switching voltages, two key problems must be solved: compensation of statistical threshol /ariations over the surfaces of the chips, and reduction of power supply switching noise. We have devised several techniques for adaptively controlling the threshold voltage by tuning the substrate bias of each well in which a large block of gates is fabricated. We have also developed a variety of packaging and interconnect techniques for noise reduction, including the use of special shielding structures and area-array chip attachments. In Phase II we will design, fabricate and demonstrate a real-time FFT computation engine using ultra-low-power CMOS and advanced multi-chip module technology. The engine will have an equivalent throughput of 30 GOPS and a power consumption of 1.0 watt. In unpackaged form, it will occupy a volume of only 2.0 cubic centimeters and weigh only 4 grams.

SPECIALTY DEVICES, INC.
1104 SUMMIT AVENUE, SUITE 104
PLANO, TX 75074
Phone: (214) 578-7501
Topic#: 93-023 ID#: 93AL -217
Office: AL
Contract #: F41624-93-C-5003
PI: Paul D Higley

Title: A True Three Dimensional Monitor for Aerospace Applications

Abstract: We propose to build, test, and characterize a three dimensional monitor for the direct display of three (or higher) dimensional information. Our device is constructed of a three dimensional array of pixels, actually "voxels," which in their quiescent state are transparent. When these elements are excited optically, through a fiber optic pigtail, they fluoresce. The sum of many fluorescing elements thus compose a three dimensional image. This spatial monitor will be used in many applications to visualize, and interact with, three dimensional images. In particular, Air Force applications will greatly benefit from this novel human/machine interface. For example, the situational awareness of a operator engaged in a three dimensional task will be greatly increased. When coupled with a two dimensional display for horizon views, this three dimensional monitor will be a useful training platform.

SPECTRA DIODE LABORATORIES, INC.
80 ROSE ORCHARD WAY
SAN JOSE, CA 95134
Phone: (408) 943-9422

Topic#: 93-079
Office: PL1
Contract #: F29601-93-C-0148
PI: DR. DAVE MEHUYS

ID#: 93PL1-927

Title: 1 W CW, Diffractor-limited Eyesafe Laser Diode Emitting at 2.0um Wavelength

Abstract: Spectra Diode Laboratories proposes to develop a 1 watt output power, continuous-wave, coherent and diffraction-limited laser diode operating in the eyesafe mid-infrared spectrum at a wavelength of 2.0 microns. The device is fabricated from a strained-layer, multi-quantum-well InGaAs/InGaAsP epitaxial wafer. The laser design consists of a single-mode distributed Bragg reflector master oscillator monolithically integrated with a flared-contact power amplifier. The flared amplifier cleanly upscales the single-spatial-mode, single-frequency output of the master oscillator up to the 1 Watt power level. The output beam, after exiting the collimation optics, consists of a single Gaussian diffraction-limited lobe. The laser source itself offers a very high electrical-to-optical conversion efficiency exceeding 15% and is a mechanically stable, self-aligned structure offering high reliability. The laser head is compact, rugged and passively cooled, therefore offering many advantages over competing high-power infrared lasers such as CO2 and solid-state Holmium-doped YAG and YLF. Due to its high output power and high efficiency, the coherent eyesafe semi-conductor laser will find numerous applications within the government and the private sector.

SPECTRA DIODE LABORATORIES, INC.
80 ROSE ORCHARD WAY
SAN JOSE, CA 95134
Phone: (408) 943-9411

Topic#: 93-084
Office: PL1
Contract #: F29601-93-C-0070
PI: DR. ROBERT LANG

ID#: 93PL1-932

Title: Diode Based Mid-IR Source Using Quasi-phased Matched Non-linear Materials

Abstract: Spectra Diode Laboratories proposes to develop mid-IR sources based on non-linear mixing of radiation from semiconductor laser diodes in quasi-phase-matched (QPM) non-linear waveguides. Use of QPM waveguides for the mixing process enables one to achieve high optical power densities over long interaction lengths and allows phase-matched interactions in common non-linear material (e.g., LiNbO3) at the wavelengths at which semiconductor laser diodes provide the highest field intensities, i.e., 670-11nm. By using the recently developed SDL monolithic master oscillator power amplifier (M-MOPA) as a >1 W cw single-mode pump source, high optical conversion efficiencies may be achieved. Frequency mixing in a QPM waveguide with one or more M-MOPA diode laser sources will provide a compact, robust, stable, and efficient source of mid-IR radiation that can be based on either parametric amplification and/or parametric oscillation. Spectra Diode Laboratories is ideally suited to carry out the proposed research due to SDL's simultaneous experience with QPM waveguides and unparalleled development of high-power semi-conductor laser sources.

SPECTRA DIODE LABORATORIES, INC.
80 ROSE ORCHARD WAY
SAN JOSE, CA 95134
Phone: (408) 943-9411

Topic#: 93-088
Office: PL1
Contract #: F29601-93-C-0102
PI: DR. RANDY GEELS

ID#: 93PL1-943

Title: High Power Fiber Coupled Visible Semiconductor Laser Diodes

Abstract: Spectra Diode Laboratories proposes to develop a fiber coupled visible laser diode emitting 10 W of continuous wave red light at an emission wavelength of 670 nm. An output power of 10 W represents more than an order of magnitude increase beyond present commercially available visible laser diode systems. The laser diode is fabricated from an epitaxial InGaP/AlGaInP layer structure grown lattice matched to a GaAs substrate. Epitaxial growth is done by metal organic chemical vapor deposition. The active layer utilizes a quantum well active region resulting in a laser diode with very low threshold current and high power conversion efficiency. Light from a monolithic array of broad area laser diodes is coupled into an optical fiber. A standard optical fiber is connected to conveniently deliver the light to any location. The result is an efficient, high power visible laser diode in a rugged, compact, reliable package. The availability of such a high power visible laser diode will spur numerous applications in military and commercial arenas.

127

SPECTRA DIODE LABORATORIES, INC.
80 ROSE ORCHARD WAY
SAN JOSE, CA 95134
Phone: (408) 943-9411
Topic#: 93-088
Office: PL1
Contract #: F29601-93-C-0105
PI: DR. DAVE MUNDINGER
ID#: 93PL1-944
Title: Advanced Development of Fiber Coupled Diode Lasers
Abstract: Recently, much effort has been made to develop semiconductor laser technology. As a result, the device technology has matured so that power levels, and lifetimes are more than adequate for many practical applications. Laser diode array bars are available which produce up to 100 watts per cm of optical power. With this impressive device capability more and more applications are emerging and the emphasis is now shifting to the optical and thermal management systems which can best take advantage of the high brightness and power levels. For optical management, one attractive option is fiber coupling. Fibers offer a simple, inexpensive, low loss method for delivering optical power in a way that preserves the intensity and brightness of the source and at the same time offers a wide range of architectural options for subsequent systems which spectrally, spatially or temporally reformat the power. For thermal control microchannel coolers have been demonstrated with thermal impedance less than .015 C/(W/cm2). SDL proposes to assess DoD and commercial applications for fiber coupled sources in the 50 to 100 watt average power range and develop a design based on the 100 watt bar, a 600 micron fiber link, and microchannel cooling.

SPECTRA RESEARCH, INC.
PO BOX 495
DAYTON, OH 45459
Phone: (513) 436-4454
Topic#: 93-158
Office: XRX
Contract #: F33615-93-C-1342
PI: Paul D. Zidek
ID#: 93XRX-151
Title: CW Laser Detection Techniques
Abstract: Spectra Research, Inc. (S*R) proposes to develop and demonstrate a technique for detecting low power CW laser sources operating in the visible (0.4-1.1 m), near infrared (1.0-3.0 m), and far infrared (9.0-11.0 m) spectral bands and to formulate a design for a visible spectral band system for fabrication in a Phase II effort. The technique, depicted, employs a novel etalon based detection approach to provide strong discrimination against non-laser background sources and provides wide spectral and angular coverage needed to protect valuable assets. This approach will achieve high resolution in direction of arrival (DOA) by using an auxiliary shadow channel and will provide high resolution in threat wavelength determination. It will achieve reliable detection at ranges in excess of several kilometers.

SPECTRA-METRICS CORP.
3700 THANKSGIVING TOWER, 37 ELM STREET
DALLAS, TX 75201
Phone: (510) 254-4239
Topic#: 93-090
Office: PL3
Contract #: FO4611-93-C-0079
PI: Robert J. Cattolica, PhD
ID#: 93PL3-019
Title: The Effect of Arcjet Preheating on the Sooting Characteristics of Methane
Abstract: The potential for improvement in the performance of electric rocket motors (arcjets) using methane as a propellant has been limited by sooting or choking and the resulting fouling of the rocket. If its sooting characteristics can be mitigated by rocket motor design or operational conditions, then its use as a propellant gas can be realized. For orbital transfer, we propose to investigate whether operational conditions, particularly preheating of the electric rocket motor, can be used to prevent fouling. For preheating purposes, hydrogen will be used to bring a 14 kw arcjet up to operational temperature. Methane will be introduced as the propellant gas by going through a series of H2/CH4 mixture compositions for 100-percent hydrogen to 100-percent methane. Sooting characteristics will be monitored by periodic disassembly and inspection of the arcjet motor internal surfaces. During actual operational testing, a spectrograph with an imaged-intensified diode array detector will be used to measure the emission spectra from the rocket motor exhaust plume. To monitor the effect of the appearance of soot, the exhaust plume emission spectrum will be studied to determine any spectral changes due to black body emission from soot.

SPECTRA-METRICS CORP.
3700 THANKSGIVING TOWER, 37 ELM STREET
DALLAS, TX 75201
Phone: (510) 254-4239
Topic#: 93-184
Office: WL9
Contract #: F33657-93-C-2231
PI: Dr. Robert J. Cattolica
ID#: 93WL9-015
Title: Three-dimensional Mapping (3D) of Hypersonic Flow Fields Using Electron-beam Fluorescence

Abstract: Advanced experimental methods that can provide quantitative flow field imaging data in hypersonic flows are required for the development of advanced hypersonic technology and the validation of computational fluid dynamic codes. To satisfy this requirement, an evaluation of potential improvements to the wind tunnel at Wright Laboratories will be conducted. Methodologies for improvement in the measurement of the density, rotational and vibrational temperature of molecular nitrogen well be evaluated in the context of the existing electron-beam source, imaging system, and wind tunnel operating characteristics. Essential features of the electron-beam fluorescence technique to be used in the evaluation include: beam propagation characteristics, spatial resolution, simulation of fluorescence spectra and signal level, and minimum measurement time requirements to maintain an acceptable signal-to-noise ratio. Recommendations will be provided on the design characteristics of an appropriate electron-beam fluorescence imaging system and associated image processing schemes to obtain quantitative flow field measurements of gas density and temperature in a hypersonic flow.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 93-020 ID#: 93AFO-109
Office: AFOSR
Contract #: FQ8671-9301356
PI: Anton C Greenwald, Ph.D

Title: ErAs/GaAs Superlattice Infrared Detector by Chemical Vapor Deposition

Abstract: Erbium-arsenide is a metallic alloy with a crystal lattice parameter close to that of GaAs. If a superlattice of these materials can be fabricated, and if its electrical properties are similar to those of the superlattice of the metallic alloy HgTe and the semiconductor CdTe, then an ErAs/GaAs combination could be found with an effective bandgap of 0.1 eV, suitable for long wavelength infrared detection. In Phase I Spire will attempt to deposit ErAs epitaxially on GaAs by low pressure metalorganic chemical vapor deposition (LP-MOCVD) and measure its electrical properties. ErAs has never been deposited before by CVD. This innovative research is possible now through the development of new source chemicals related to rare earth doping of semiconductors. Fabrication of a superlattice structure would be attempted in Phase II.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 93-067 ID#: 93PL1-316
Office: PL1
Contract #: F29601-93-C-0089
PI: FEREYDOON NAMAVAR, Sc.D.

Title: Radiation-hard CCD Detectors and Imagers for Space Applications

Abstract: Silicon-on-insulator (SOI) materials have been used extensively to fabricate electronic circuitry which must operate in harsh radiation environments. Spire proposes to extend the advantage of radiation hardness to highly efficient visible light detectors and imagers by building them on SOI substrates produced by the SIMOX (Separation by IMplantation of OXygen) process. Recent advances in SIMOX technology have resulted in the commercial availability of very high quality SOI substrates. Among these advances has been Spire's development of a low energy SIMOX (LES) processing yielding ultra-thin structures with very low defect density. The first SIMOX-based n-on-p photodiodes capable of efficient visible light detection were fabricated at Spire, where it has also been shown that the silicon top layer thickness can be adjusted to confer wavelength selectivity on these photodiodes. In Phase I several test structures, including CCDs, will be fabricated on high-quality SIMOX substrates, then their electrical and optical performance will be measured before and after irradiation and compared to that of conventional detectors. In Phase II, detector design will be perfected, fabrication processes optimized, and advanced, radiation-hard CCD imagers constructed on SIMOX wafers will be demonstrated.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 93-072 ID#: 93PL1-084
Office: PL1
Contract #: F29601-93-C-0040
PI: RAMESH B. PATEL

Title: Diamond Coated Insulators for Energetic Plasma Environments

Abstract: Many plasma systems require electrical insulators that are exposed to energetic particles, ultraviolet radiation, x-rays, high rf and dc electric fields, and heating; the insulator surface and structure can be damaged by the plasma environment, causing degradation of system life-time and performance. Heavy elements from insulator erosion can produce serious radiation losses from high temperature plasmas. An adherent coating which is resistant to energetic particles, photons, and heat, and

which has low atomic number and sputtering yield, would improve insulator performance and minimize radiation losses. Diamond and diamond-like films, applied by chemical vapor deposition (CVD) processes, appear to have considerable potential for coating insulators in plasma devices. Spire proposes to investigate the properties of very fine-grained polycrystalline diamond and diamond-like films on polymer and ceramic insulators. Samples will be coated and exposed to a simulated plasma environment in a modified flash-over testing facility. The coatings will be evaluated from real-time diagnostic data and post-test analysis of adhesion, microscopic damage, weight loss, and composition of erosion products. Phase I research should lead to Phase II, in which insulator structures from plasma devices, such as Phillips Laboratory's Working Fluid Experiment or MARAUDER compact torpid experiment, are coated with diamond and/or diamond-like carbon and evaluated under actual operating conditions.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 93-080 ID#: 93PL1-045
Office: PL1
Contract #: F29601-93-C-0060
PI: KURT J. LINDEN, Ph.D.

Title: Design and Modeling of 2-5 um Quantum Confinement Lasers of InAs/GaInAs/InP

Abstract: This program will model various laser structures with 1, 2, and 3-dimensional carrier confinement in the InAs/GaInAs/InP material system. The innovative choice of this system is based on the fact that it is relatively easy to grow. The GaInAs/InP system is widely used for fabricating 1.3 um and 1.55 um LEDs, lasers and detectors for telecommunication applications. The addition of an InAs strained layer is easily achieved, provides the device designer with great design freedom and leads to a structure which emits radiation in the 2-3 um spectral region at 300K. The only other III-V compound semiconductor material capable of emitting in the 2-3 um spectral region at 300K is the complex quaternary Sb-constraining GaInAsSb/AlGaAsSb/GaSb system, and because it is not commonly used, miscibility gaps make it difficult to grow and requires GaSb substrates; these are not widely available and have a low melting temperature. In Phase I the optimum strained GaInAs/InP system will be identified. The in Phase II, actual growth of the InAs/GaInAs/InP epitaxial structures by the widely-used MOCVD technology will be carried out. Strained quantum well lasers will then be fabricated in a variety of 1, 2, and 3-dimensional confinement configurations. Such multidimensional confinement structures in these long-wavelength materials are expected to exhibit improved 300K device characteristics because of reduced Auger recombination effects.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 93-082 ID#: 93PL1-176
Office: PL1
Contract #: F29601-93-C-0066
PI: H. PAUL MARUSKA, Ph.D.

Title: Agile InAlAs/InGaAs Multi-quantum Well Fabry-Perot Filter

Abstract: Band-gap-resonant optical non-linearities in III-V compound semiconductor materials provide the basis for novel components, allowing advances in optical signal processing. Of particular interest to future Air Force efforts are electrically tuned multi-element spectral filters, which can be utilized in spectral imaging and automated target recognition (ATR) systems. Other applications for this technology would be optical interconnects, computing, communications, and logic circuits. We propose to prepare a tunable Fabry-Perot spectral filter using MOCVD crystal growth. An advanced InAlAs/InGaAs multi-quantum-well structure will be developed which will exhibit the lateral electric-field-induced refraction (LEFIR) effect, leading to a tunable filter. The lightwave propagates transverse to a stack of layers, while the electric field, applied in the lateral direction, induces changes in the refractive index of the active region containing the quantum wells. The index change results from the removal of a two-dimensional electron gas, which is supplied by planar doping. Configured as a Fabry-Perot interferometer using two stacks of Bragg mirrors, the transmissive modes are shifted in wavelength when the effective refractive index of the active region is altered by the applied field, creating the filter. In Phase II, the work will be expanded to create fully operational two dimensional arrays of these tunable optical filters.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 93-088 ID#: 93PL1-044
Office: PL1
Contract #: F29601-93-C-0077
PI: KURT J. LINDEN, Ph.D.

Title: Advanced Fiber Coupled High Power Diode Laser Module
Abstract: This program will develop high power diode lasers in compact packages with fiber optic output. The approach will involve design, fabrication, and mounting of single high power CW diode laser array bars and the fiber pigtailing of these bars into completed laser modules. The approach will be to use single array bar packages, thereby avoiding the expensive "rack and stack" design. A single 1-cm array bar package will be pigtailed into a 400 micron diameter core fiber, with an expected CW output power in the 10W level. The uniqueness of the proposed approach is that it will utilize Spire's previously developed low cost laser array bar fabrication techniques, and provide for the coupling of these bars into a single fiber delivery system. Spire uses proprietary fluxless vacuum soldering for mounting 1 cm, coated array bars without solder voids, and proposes to use all-refractive optics for efficient fiber coupling. The Phase I effort will result in the delivery of a proof-of-concept fiber-coupled demonstrator emitting at the 10W level. Future Phase II work will be directed at extending this approach into the 50-100W level.

SPIRE CORP.
ONE PATROITS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 93-140
Office: WL5
Contract #: F33615-93-C-5338
PI: Stanley M Vernon

ID#: 93WL5-254

Title: Ordered Gallium Indium Phosphide as a New Non-linear Optical Material
Abstract: We propose development of ordered Ga1-xInxP grown by metalorganic chemical vapor deposition (MOCVD) on GaAs as a material showing very strong non-linear optical (NLO) effects. With a bandgap of approximately 1.85 eV, lattice-matched, ordered Ga1-xInxP (x = 0.49) is useful as an NLO material with light from GaAs-based lasers. Although most III-V alloys have been found to show ordering effects under certain growth conditions, it is well known that MOCVD-grown Ga1-xInxP displays very strong ordering of the Ga- and In-sublattices along (111)-type directions, and that the degree of ordering is controlled by growth parameters; strong ordering should lead to the large birefringence needed for NLO applications. A film grown on a (100) GaAs substrate will have the optical ("C") axis of the material at an angle of 54.7 degrees to the wafer surface, thus enabling tuning of an NLO system by simple rotation of the Ga1-xInxP film with respect to the incoming laser. Phase I will determine deposition parameters which yield the greatest degree of ordering, and the strongest non-linear optical effect. Measurements will include atomic ordering and birefringence versus growth conditions. Phase II will optimize the growth of Ga1-xInxP so that the second-order non-linear-optical susceptibility and birefringence are maximized. We will then design, fabricate, and test a GaAs-Ga1-xInxP device which utilizes the NLO properties, such as an optical parametric oscillator. Development may be extended to (A1yGa1-y) 0.5In0.5P to increase the bandgap.

SQM TECHNOLOGY, INC.
P.O. BOX 2225
LA JOLLA, CA 92038
Phone: (619) 481-7182

Topic#: 93-022
Office: AFOSR
Contract #: FQ8671-9301339
PI: Walter Podney

ID#: 93AFO-078

Title: High Temperature SQUID Microprobe for Eddy Current Evaluation of Airframes
Abstract: Superconductive Quantum Interference Devices (SQUIDs) bring new physics, new technology, and new capability to eddy current nondestructive evaluation (NDE) of materials. A SQUID offers new technology for measurement of magnetic flux at low frequencies with unprecedented sensitivity. Its extreme sensitivity at low frequencies can provide an electromagnetic microscope for eddy current NDE of underlying defects and hidden corrosion in airframes. Our measurements with a prototype SQUID microprobe, using niobium technology at 4 K, show that it reliably finds a 1 mm flaw through 6 mm of aluminum, at 88 Hz and a standoff of 4 mm, as well as material loss less than 1% from corrosion under a 2.29 mm thick aluminum plate. The new capability offered by a SQUID microprobe together with advances in fabricating SQUIDs and pickup coils from high-temperature superconductors provides a technological opportunity for developing a hand-held, electromagnetic microscope for evaluating hidden defects in airframes during flight-line operations. Its development requires the combined skills of experts knowledgeable in (1) eddy current NDE of materials, (2) NDE of military and commercial airframes, (3) fabrication of SQUIDs from high-temperature superconductors, and (4) use of SQUIDs for eddy current NDE. To realize the promise of a new capability for inspecting the aging fleets of both military and commercial aircraft, we propose to lead a development team comprising IBM, Northrop Corporation, Boeing, and SQM Technology, Inc.

SRICO, INC.
664 PETWORTH COURT
POWELL, OH 43065
Phone: (614) 846-3239

Topic#: 93-088 ID#: 93PL1-063
Office: PL1
Contract #: F29601-93-C-0050
PI: S. SRIRAM

Title: USAF - Phillips Laboratory; Technology Transfer Passive Wideband Electromagnetic Field Sensors

Abstract: The present method of detecting wideband pulsed and continuous wave (CW) electromagnetic fields utilizes asymptotic conical dipole devices. Because of the metallic nature of this device, the electromagnetic fields are perturbed and lead to inaccurate measurements. In addition, since this is a D-dot (theta-D/theta-t) sensor, the sensor output must be integrated to obtain the electric field. These problems of the asymptotic conical dipole could be overcome by using photonic sensors fabricated using integrated and fiber optic technologies. The photonic sensor is fabricated from an electrooptic, dielectric crystal material such as lithium niobate (LiNbO3). The sensor head and the input and output fibers offer very minimal perturbation to the electromagnetic fields. This is a passive device that does not require any power supply to the sensor head. We propose the development and laboratory demonstration of miniature electric field sensor devices that can operate from DC to 10 GHz with a dynamic range of 56 dB. The sensor devices will be fabricated with input and output optical fibers for testing and evaluation. This Phase I program would develop low cost, miniature, integrated optic electromagnetic field sensors that could completely satisfy the electromagnetic field measurement requirements of the Air Force for LPM, HPM, and UWB test applications.

STATISTICAL SIGNAL PROCESSING, INC.
6950 YOUNT STREET
YOUNTSVILLE, CA 94599
Phone: (707) 944-0648

Topic#: 93-110 ID#: 93WL2-052
Office: WL2
Contract #: F33615-93-C-1249
PI: William Gardner

Title: A Low-cost General Purpose Spectral Correlation Analyzer

Abstract: A feasibility study for a low-cost general purpose Spectral Correlation Analyzer (SCA) for laboratory use will be performed. The desired SCA will accept both analog and digital inputs, and will provide graphics and text output on a screen and for external storage. The SCA will include a flexible graphical user interface and will be especially user friendly. A system architecture that uses off-the-shelf hardware, including a host computer, will be designed and the hardware components will be specified in Phase I, but the software for the host computer will be written in Phase II. It is hoped that this feasibility study will lead to the first commercially available SCA for use in academic, industrial, and government laboratories.

STEROIDS, LTD.
CHICAGO TECHNOLOGY PARK, 2201 W CAMPBELL PARK DR
CHICAGO, IL 60612
Phone: (312) 421-1819

Topic#: 93-091 ID#: 93PL3-054
Office: PL3
Contract #: FO4611-93-C-0082
PI: Liang Guo

Title: Novel Synthesis of Cubane Precursor

Abstract: Cubane C8H8 is potentially an extremely valuable fuel substitute for the kerosene-based rocket propellant RP-1. The classical Eaton synthesis to yield cubane 1,4-dicarboxylic acid in five steps involves a key photochemical reaction. The steps before and after the critical 2+2 cycloaddition are standardized and readily scalable. However, these steps alone prevent scale-up. We will develop a non-photochemical method for these steps. We propose three chemical alternatives: a) radical cation 2+2 cycloaddition via a radical chain process, b) a cobalt catalyzed 2+2 cyclodimerization and c) a nucleophilic addition-cyclization route. Rapid analysis for the success in non-photochemical reaction of the chemical 2+2 is easily done because the properties of the product are already known. Therefore during the six month period of Phase I we will start a screening of many one-electron oxidants for radical cation formation (route a), exhaustively vary reaction parameters for the cobalt catalyzed cyclodimerization, (route b) and investigate a representative number of nucleophiles capable of triggering the intramolecular cyclization in route c.

STI OPTRONICS, INC.
2755 NORTHUP WAY
BELLEVUE, WA 98004
Phone: (206) 827-0460

Topic#: 93-085 ID#: 93PL1-152
Office: PL1
Contract #: F29601-93-C-0073
PI: CHARLES H. FISHER

Title: Solid-state Laser Pumped 3-5 Micron Lasers
Abstract: We propose to develop a solid state laser pumped 3-5 micron gas laser for tactical airborne countermeasure applications. This laser will be an alternative to damage prone non-linear optics for down converting existing diode pumped solid state lasers into the mid-infrared. In Phase I we will examine existing data on mid-infrared gas lasers and existing solid state lasers and select a system that will satisfy the application requirements. In Phase II we will demonstrate the 3-5 micron laser system. The diode pumped solid state pump laser will be scaled to the 100 W level and will be available for other government or commercial applications.

STR CORP.
10700 PARKRIDGE BOULEVARD, SUITE 200
RESTON, VA 22091
Phone: (703) 758-1100
Topic#: 93-161
Office: XRX
Contract #: F33657-93-C-2334
PI: Wilfred Leon Godson
ID#: 93XRX-191
Title: Development of a Decision Support Tool for Development Planning
Abstract: The extraordinary political changes since 1989 have led to abrupt and fundamental changes in the National Military Strategy of the United States, which in turn have totally altered the focus and substance of U.S. military force planning--and led to increased demands for improved development planning. This puts the development planner into a particularly acute predicament for two reasons: the development planner has an enormous span of responsibility, and tools which were barely adequate even before the increased emphasis on development planning--much less now. In the last three years, much progress has been made in treating certain elements of the force planning and acquisition problem, specifically in the development and production of a core set of force effectiveness parametrics applicable to conventional warfare in which theater level campaign analyses were performed within the "Strategy to Task" as well as the acquisition directives (DoDI 5000.1/.2). This proposal takes advantage of the applicable elements of that progress to create a tool that will substantially reduce the development planner's burden.

STRAINOPTIC TECHNOLOGIES, INC.
108 WEST MONTGOMERY AVE
NORTH WALES, PA 19454
Phone: (215) 661-0100
Topic#: 93-126
Office: WL4
Contract #: F33615-93-C-3408
PI: Alex S. Redner
ID#: 93WL4-034
Title: Integrated Optical-and-digital Data Acquisition System for Dynamic Surface Displacements and Stress Analysis of Aircraft Tires
Abstract: The objective of the proposed research is to develop an integrated system for dynamic stress analysis of aircraft tires. The system will use the Projection-Moire concept, whereby a high-density line-set of Master Grating is projected on the investigated surface. The projected lines, deformed by the displacements and bending of the investigated surface is then optically recombined with a reference set, producing the Moire Fringe pattern. An operational system will be assembled and testing will be conducted to prove the feasibility of the proposed approach. The designed system will include a projection master and a PC-controlled CCD camera to receive the image, and produce the Moire fringes, using software generated reference grating. Software will be developed to analyze the fringe pattern, retrieving the displacement and stress information.

STRESS PHOTONICS, INC.
565 SCIENCE DRIVE
MADISON, WI 53719
Phone: (608) 233-2878
Topic#: 93-186
Office: WL9
Contract #: F33657-93-C-2230
PI: John R. Lesniak
ID#: 93WL9-042
Title: Differential Thermography for Extreme Environment Structural Integrity Measurement
Abstract: Advanced aircraft designs require technology improvements that incorporate the use of advanced materials and material systems for high specific stiffness and temperature capabilities. Improved crack detection and material property measurement techniques are required to support the development and verification of material systems. A development program is proposed that will improve for high-temperature application two thermography techniques to enable the quantification of flaws both in terms of geometry and stress intensity factors. Forced Diffusion Thermography (FDT) is an NDE method that uses projected, dynamic patterns of light to thermally excite a specimen structure with an oscillating thermal pattern that is synchronously imaged and processed for the detection of flaws. Thermoelastic Stress Analysis (TSA) is a differential thermography technique

capable of nearly real-time measurement of mixed-mode stress intensity factors. Both FDT and TSA use the same dynamic thermography equipment to measure the small temperature fluctuations upon which these techniques are based. FDT and TSA have several attributes that will make them superior to other methods for assessing structural integrity in extreme environments. FDT and TSA are non-contact full-field techniques, not significantly impaired by convection currents or other anomalies in a high-temperature environment, able to work on a wide range of materials and composites, and able to produce standard(DC)thermal images as well as differential(AC)thermal images.

SUMMATION, LTD.
709 TALBOTT DRIVE
KETTERING, OH 45429
Phone: (513) 294-7394

Topic#: 93-158 ID#: 93XRX-167
Office: XRX
Contract #: F33657-93-C-2332
PI: James R. Atchison

Title: Long-term Planning Concept for Integration of Non-defense Missions Into Aeronautical Systems/Subsystems
Abstract: The objective of this project is to examine the feasibility of developing a long-term planning concept for determining the utility of incorporating non-defense related mission equipment into future Air Force weapon systems. This project will concentrate on the addition of equipment necessary to conduct a counter-drug mission using special operations aircraft designed to support A-Team and Seal Platoons. To develop functional capability requirements for a joint special operations/counter-drug aircraft, this project will examine the following areas: 1. Wide Area Surveillance; 2. Detection of drug movements; 3. Tactical technologies; and 4. Day-to-day operation enhancements. The effort to be accomplished during Phase I will include the definition of an integrated concept for planning for the co-development of non-defense functions during pre-Milestone I planning; and a utility assessment for determining the impact that non-defense devices and missions have on the design of future aircraft weapon systems.

SUNREZ CORP.
1374 MERRITT DR
EL CAJON, CA 92020
Phone: (619) 442-3353

Topic#: 93-145 ID#: 93WL5-340
Office: WL5
Contract #: F33615-93-C-5377
PI: W Novis Smith

Title: Optically Clear Canopy Repair Adhesive
Abstract: This six-month program will demonstrate that a UV light cured repair resin for aircraft canopies is practical and that the repair will have good optical clarity, good structural physical properties, and good adhesion. (Sunrez has already demonstrated that its light cured resins for an exploratory acrylic canopy repair are simple and rapid using sunlight as the light source.) The program will initially develop optical repair resins for both acrylic and polycarbonate canopies. However the principal focus of Phase I will be on the development of acrylic canopies. The repair patch will require a reinforcement fiber which will be optically clear when cured in the resin to form the overall patch. In addition to developing the patch, initial work on the proper repair procedures for these canopies with this new light cured patch will be performed. The success of this program will demonstrate a practical optically clear, structural patch for aircraft canopies along with the repair techniques. Phase II will optimize this patch system and produce the corresponding patch for polycarbonate canopies.

SUPERCONDUCTOR TECHNOLOGIES, INC.
460 WARD DR, STE F
SANTA BARBARA, CA 93111
Phone: (805) 683-7646

Topic#: 93-142 ID#: 93WL5-301
Office: WL5
Contract #: F33615-93-C-5342
PI: Michael M Eddy

Title: New Approach for Large Area High Tc Thin Film Technology
Abstract: The overall objective of this program is to develop a high temperature superconductor (HTS) / low e dielectric / HTS layer structure, where the low e dielectric will have comparable dielectric constant to the layers used in conventional electronic packaging (2.5-5). A high quality, HTS / low e dielectric / HTS layer structure is the enabling technology for many different applications including multi-chip modules, interconnects and high frequency microwaves. HTS interconnects offer significant reductions in rise time caused by RC time constant effects; however, the lowest possible effective dielectric constant is necessary to minimize the signal delay time. Inter-layer shorts and the high dielectric constant of possible materials for epitaxial growth has hindered the building of tri-layers. Tri-layers have been demonstrated on small area (1cm2), but invariably have problems with outgrowths and boulders puncturing the dielectric layer unless a planarization step is used. The focus for the work in Phase

I of this program is to investigate laminating superconductor layers with intermediate organic polymers. The self supporting YBCO will be generated using novel etching procedures.

SUPERIOR VACUUM TECHNOLOGY, INC.
7620 EXECUTIVE DRIVE
EDEN PRAIRIE, MN 55344
Phone: (612) 934-1993
Topic#: 93-019 ID#: 93AFO-069
Office: AFOSR
Contract #: FQ8671-9301364
PI: Peter Chow
Title: Quantum Well and Superlattice IR Detector Development
Abstract: Strained layer superlattices of GaInSb/InAs have been shown to have many desirable optical and transport properties, especially for VLWIR (>12um) detection. We propose to explore its fabrication and device applications by growing on polar orientations. It is expected the piezoelectric effect would beneficially extend its IR response to longer wavelength. This will also make material parameters more flexible so that device structures are more easily optimized. Comprehensive theoretical calculation, and experimental fabrication and characterization will be carried out.

SURFACES RESEARCH & APPLICATIONS, INC.
8330 MELROSE DRIVE
LENEXA, KS 66214
Phone: (913) 541-1221
Topic#: 93-158 ID#: 93XRX-208
Office: XRX
Contract #: F33657-93-C-2272
PI: Paul Sutor, Ph.D.
Title: Improved Threaded Fastener Coatings for Turbine Engine Applications
Abstract: Maintenance of Air Force turbine engines is hampered by threaded fasteners which have seized and cannot be removed, particularly in high-temperature turbine sections. Removal of these fasteners for routine maintenance often results in galled, seized or broken parts, with accompanying damage to the mating parts and lost maintenance time. This is very costly to the Air Force. Surfaces Research has developed new lubricant technology which promises to solve fastener lubricant problems. In the Phase I program, we will demonstrate improved anti-seize fastener lubricant performance using new Surfaces Research lubricant technology. We will elucidate the chemical and metallurgical mechanisms which cause seizing or galling of fasteners in Air Force engines. We will establish the relationships between fastener lubricant performance in engines and in component screening tests.

SY TECHNOLOGY, INC.
4900 UNIVERSITY SQUARE, SUITE 8
HUNTSVILLE, AL 35803
Phone: (205) 722-9095
Topic#: 93-087 ID#: 93PL1-147
Office: PL1
Contract #: F29601-93-C-0076
PI: RODNEY L. CLARK
Title: An Innovative Approach to High Speed Measurement of an Aero-optically Distorted Wavefront
Abstract: Aerodynamic flow about flight vehicles with an onboard optical sensor often contributes to image degradation of the optical signal received by the sensor. This phenomenon is called aero-optic degradation, and is caused by the wavefront distortion optical radiation suffers upon transmission through the aerodynamic environment. This aero-optic degradation occurs on a continuous spatial and temporal basis, and can be quite severe, especially when the aerodynamic environment is highly turbulent. Progress in the design of reliable flight optical sensors requires an ability to accurately determine the impact aerodynamic flow environments have on propagating optical radiation. This proposal presents an innovative instrument to directly measure the aero-optically distorted wavefront at high speed and high resolution in the aerodynamic environment. The device consists of a specially designed Hartmann Wavefront Sensor (HWS) adapted to a high speed camera, which will provide phase maps of the time varying aero-optic distortions imposed on optical waves at the high temporal frequencies and small spatial resolutions required to meet the need for an optical diagnostic tool for aerodynamic turbulence research. The adaptation of an ingenious high speed adaptive optical element provides a new opportunity to perform "real-time" correction to the distorted waves measured by our HWS sensor. Miniaturization of this diagnostic tool could provide the solution to optical sensing on-board flight vehicles.

SYMVIONICS, INC.
3452 E. FOOTHILL BLVD.
PASADENA, CA 91107
Phone: (818) 585-0115
Topic#: 93-109 ID#: 93WL2-039
Office: WL2
Contract #: F33615-93-C-1257
PI: Mark Barnett
Title: Avionics Software Design Complexity Measure (ASDCM)
Abstract: Complexity has been shown to be a valid measure of software maintainability. However, software complexity measures are currently focused on the analysis of completed code. Since an improvement in the design phase of a software product would reduce the overall cost of that software (i.e., identify problems early in the software's life cycle), it only makes sense to develop a metric which addresses software design complexity. The ability to objectively evaluate and measure the design complexity of software would allow a software developer to evaluate and compare competing candidate designs prior to any coding activities. Comparing design early in the software design cycle would then permit an early evaluation of the anticipated maintainability (and quality) of the final software product. The objective of this SBIR activity is to identify appropriate software design complexity methods for an eventual development of an automated tool which identifies and measures software design complexity. With the adherence to emerging standards and interoperability with other Computer Aided Software Engineering (CASE) tools, a fully developed Avionics Software Design Complexity Measure (ASDCM) would certainly be a desirable feature of a modern Software Engineering Environment.

SYNECTICS CORP.
111 E. CHESTNUT ST.
ROME, NY 13440
Phone: (315) 337-3510
Topic#: 93-035 ID#: 93ES3-221
Office: ES2
Contract #: F30602-93-C-0139
PI: Randal K. More
Title: Future Technologies and System Capabilities Analysis Tool
Abstract: The focus of this effort is to construct a software system to help technology planners assess current and future technology. The system will be based on advanced interface, data base, expert system, and hypertext concepts. Implementation will rely heavily on off-the-shelf components. The goal is to increase planning efficiency and accuracy, reduce program risks by helping set realistic goals, and reduce duplication of effort between projects. The effort is based on a unique combination of existing components and technologies and has wide potential application to both civilian and government technology planners.

SYNETICS CORP.
540 EDGEWATER DRIVE
WAKEFIELD, MA 01880
Phone: (617) 245-9090
Topic#: 93-114 ID#: 93WL2-081
Office: WL2
Contract #: F33615-93-C-1242
PI: Barry Griffiths
Title: Advanced Fire Control/Fusion Methods
Abstract: In current and developing air combat systems, issues of operational flexibility and reliability have gained substantial interest. It would be desirable for one aircraft's fire control system to be able to take advantage of sensor data from other platforms, for several reasons. First, this would give each aircraft access to sensors that it may not mount; for example, long-range search sensors or intelligence sources. Second, it would give each aircraft access to similar sensors that are differently located, and can see different targets; for example, on other aircraft in the same flight. Third, it might give an aircraft a means to carry out its mission, even when some of it sensors have failed. SYNETICS approach to solving this problem, the Multi-Aircraft Networked Tracking Architecture (MANTA), is based on recent advances in statistical filter theory that have been used successfully in other Air Force programs. The tracking filters on each aircraft accept both own-ship sensor data, at sensor (high) rates, and "summarized" other-ship data obtained through the communications channel (e.g. JTIDS) at relatively low rates.

SYNETICS CORP.
540 EDGEWATER DRIVE
WAKEFIELD, MA 01880
Phone: (619) 442-3703
Topic#: 93-131 ID#: 93WL4-071
Office: WL4
Contract #: F33615-93-C-3801
PI: Richard A. Fastring
Title: KittyHawk Instant Flight Replay (Facilitating Accident Evaluations of Aircraft with "Glass" Cockpits)
Abstract: SYNETICS proposes a novel and innovative solution to the problem of information volatility when displayed on

electronic flat-panel or CRT displays in modern glass cockpit aircraft. Unlike conventional avionics and flight control displays comprised of electromechanical gauges and dials that hold their final readings at the time of a crash, glass cockpit flight instrumentation loses all data upon a crash and provides no clues to aid the post-crash investigation. SYNETICS proposes to demonstrate the use of the new Hewlett Packard KittyHawk Personal Storage Module (a miniature rugged hard disk) properly interfaced to the video RAM of an electronic display to achieve an Instant Flight Replay capability. The primary role of the flight-recorder (black box) mounted KittyHawk Instant Flight Replay system would be post-crash flight analysis; however, with somewhat different packaging, the KIFR system would support post-flight analysis of training flights. SYNETICS proposal is especially innovative and beneficial to the Air Force for three reasons: (1) SYNETICS proposes a joint effort with Rockwell International (at no cost for Rockwell's consultation during Phase I), (2) Phase I will not be limited to a theoretical analysis of feasibility, but will include the important issues of shock and temperature testing, and (3) the KIFR will be designed both for integration inside existing flight recorders and for standalone use in military aircraft having no flight recorder.

SYSTEMS & PROCESSES ENGINEERING CORP.
1406 SMITH ROAD
AUSTIN, TX 78721
Phone: (512) 385-0082
Topic#: 93-181 ID#: 93WL0-229
Office: WL0
Contract #: F08630-93-C-0049
PI: Dr. Gary McMillian
Title: High Speed Data Acquisition Module
Abstract: Systems & Processes Engineering Corporation (SPEC) proposes to develop a high speed data acquisition module using state-of-the-art GaAs integrated circuit and Multi-Chip Module (MCM) technologies. The data acquisition MCM will include an 8-bit ADC, a custom GaAs integrated circuit, 32 Kbytes of RAM, and an 8-bit microcontroller to provide control and serial communications. The module will operate in a continuous acquisition (wrap-around) mode enabling storage of pre-trigger data. The custom IC will be implemented in Vitesse Semiconductor's 0.6 micron GaAs process for operation at a minimum of 300 MHz, with a goal of 500 MHz. A high bandwidth memory interface will be designed to take advantage of high speed, high density BiCMOS static RAMs for extended waveform storage. The GaAs IC will include a phase-locked Voltage Controlled Oscillator (VCO) to generate the sample clock, and registers, programmable by the microcontroller, to control the amount of pre-trigger delay. Data acquisition can be enabled by the microcontroller or by an external "enable acquisition" signal. An internal threshold comparator can be set for automatic level triggering, or an external "stop acquisition" signal can be applied to terminate data acquisition.

SYSTEMS CONTROL TECHNOLOGY, INC.
2300 GENG RD.
PALO ALTO, CA 94303
Phone: (415) 494-2233
Topic#: 93-089 ID#: 93PL1-218
Office: PL1
Contract #: F29601-93-C-0099
PI: DR. THOMAS L. TRANKLE
Title: Workstation Based Interactive Space Sensor Systems Simulation Package
Abstract: The Phase I research effort will specify the Integrated Simulation Environment for Networks (ISEN), an approach for integration of diverse simulation types and for data analysis. ISEN will be able to operate an integrated simulation consisting of many preexisting simulation modules, each of which will represent a component of the complete system. ISEN will use an existing integration tool for single platform and networked integration. Candidates are ToolTalk, from Sun Microsystems, and Khoros, from the University of New Mexico. ISEN will also use the Advanced Simulation Programming Environment (ASPEN), an object oriented simulation framework. This framework provides a cooperative setting for objects to interact and separates the definition of the simulation from the individual object model construction. The effort will define a version of SENSORS (Scientific and Engineering Simulations of Remote Sensors) that will be compatible with ISEN. SENSORS is an integrated simulation of satellite surveillance and communications systems. The specification of the ISEN integration framework will select the cross platform integration tool, will define a graphical user interface for presenting results to the user, will define the interface between the cross platform integration tool and ASPEN, and will define an interface shell for integration of proprietary programs.

SYSTEMS TECHNOLOGY, INC.
13766 SOUTH HAWTHORNE BLVD.
HAWTHORNE, CA 90250
Topic#: 93-123 ID#: 93WL4-046
Office: WL4
Contract #: F33615-93-C-3602

137

Phone: (310) 679-2281 PI: David G. Mitchell
Title: Investigation of the Role of Visual Cueing, Response Type, and Task on Mission-Oriented Flying Qualities
Abstract: There is a dichotomy between the government approach to the specification of aircraft flying qualities and the requirements for mission effectiveness. The present military standard for flying qualities of piloted air vehicles, MIL-STD-1797A, is a comprehensive document that has evolved over the past several decades into a "cookbook" of requirements. Unfortunately, the mission requirements for current and future aircraft include many aspects that are insufficiently covered by the specification. Primary among the shortcomings are three basic categories for research: the effect of the pilot's visual environment (cueing); 2) the effect of the response to task-tailored controls (response-type); and 3) the effect of the specific mission element (task). The Phase I program will have the following two major objectives: 1) Create the structure, format, and methodology to incorporate visual cueing, response-types, and modern tasks into a mission-oriented specification format; and 2) Generate the basic tables relating these elements in an integrated fashion. Included in this effort will be a definition of combinations of cueing/response-type/task for which further research is required. A system for evaluating the trade-offs between advanced controls and displays will be generated.

SYSTEMS TECHNOLOGY, INC. Topic#: 93-123 ID#: 93WL4-104
13766 SOUTH HAWTHORNE BLVD. Office: WL4
HAWTHORNE, CA 90250 Contract #: F33615-93-C-3611
Phone: (310) 679-2281 PI: David G. Mitchell
Title: Demonstration Maneuvers for Advanced Flight Control Configurations
Abstract: Development of advanced flight control laws for aircraft is out-pacing the evolution of the military flying qualities specifications. The use of task-tailored designs and extended flight envelopes has resulted in aircraft whose characteristics are on, or beyond, the edges of applicability of the current military standard for flying qualities of piloted airplanes. In addition, while the standard is comprehensive in scope, it is possible that external factors will influence the mission suitability of any aircraft design such that its overall flying qualities may be unacceptable, even if it passes individual criteria. The only final check of this suitability is via testing through a series of demonstration maneuvers. The proposed effort will review current flight testing and research methods to identify a limited set of maneuvers that will serve as a check of an aircraft's overall flying qualities. These maneuvers will be representative of actual flight mission elements and will include expected limits of desired and adequate performance, as required for flying-qualities evaluation. Unlike the single-axis, single-parameter criteria of the military standard, they will assure multi-axis operations.

SYSTRAN CORP. Topic#: 93-128 ID#: 93WL4-078
4126 LINDEN AVENUE Office: WL4
DAYTON, OH 45432 Contract #: F33615-93-C-3606
Phone: (513) 252-5601 PI: George J. Valentino
Title: Data Protection and Encryption Methods for Shared Memory Networks
Abstract: Replicated Shared-Memory Network (SMN) and fiber-optic (FO) communications technology has been used for several years as the means to configure multiple computational nodes into real-time simulation systems. In most cases these simulations were within a single facility, with node-to-node distances constrained to 300 meters. The use of high-power laser diodes and/or higher-power laser transmitters and receivers to extend node-to-node distance by one or two orders of magnitude (to over 30,000 meters) and the use of satellite communications to extend these distances to geographically significant distances are a natural extension of replicated shared-memory networks. SYSTRAN's SCRAMNet (Shared Common RAM Network) product currently includes "Long-Link" laser diode boosters for internode distances approaching 3,500 meters. The Avionics Wind Tunnel (AWT), an ongoing plan to connect several Wright-Patterson AFB facilities within the Flight Dynamics and Avionics Directorates, and potentially other Area B facilities, requires additional capability in order to share U.S. Government classified data in a manner approved by the National Security Agency (NSA). SYSTRAN is aware of several techniques and products that can either: (i) protect this original data while it is being transmitted (without using time consuming and data generating encryption/decryption methods), or (ii) encrypt and decrypt the data. Both techniques offer advantages and limitations for AWT real-time requirements. This SBIR program will evaluate alternative methods to protect and/or to encrypt/decrypt shared memory network communications traffic using NSA-approved algorithms/devices.

SYSTRAN CORP.
4126 LINDEN AVENUE
DAYTON, OH 45432
Phone: (513) 252-5601
Topic#: 93-158
Office: XRX
Contract #: F33615-93-C-1336
PI: George J. Valentino
ID#: 93XRX-034
Title: Reflected Memory for Avionics Inter-Processor Communication
Abstract: Abstract available from the AF SBIR office. Contact Jill Dickman at 1-800-222-0336.

SYSTRAN CORP.
4126 LINDEN AVENUE
DAYTON, OH 45432
Phone: (513) 252-5601
Topic#: 93-158
Office: XRX
Contract #: F33615-93-C-1298
PI: George J. Vaneltino
ID#: 93XRX-067
Title: A Meta-system to Support Avionics Wind Tunnel Composition and Application
Abstract: SYSTRAN proposes to formulate (in Phase I) the top-level design of a Meta System application to support users of the Avionics Wind Tunnel (AWT). The AWT is a vision, shared by members of the Avionics Directorate, Flight Dynamics Directorate, and other Wright Laboratory and Area-B facilities, for a real-time R&D facility that will utilize the most appropriate facility subsystems to accommodate the technology needs of internal and external simulation, experimentation, test, and demonstration users. Some of the facilities that will compose AWT assets include the Avionics Directorate's Integrated Test Bed (ITB), the Integrated Electromagnetic System Simulator (IESS), the Communications Systems Engineering Laboratory (CSEL), the Integrated Defensive Avionics Laboratory (IDAL), the Radar/Fire Control Lab and the Flight Dynamics Directorate's assortment of flight simulators. These assets include a mixture of digital simulation models, hardware-in-the-loop subsystems, and pilot-in-the-loop (PITL) simulators and stations. Currently, plans are being implemented to relocate some existing Avionics Directorate facilities (which are not located in Bldg 620) to Bldg 620 as part of a three-phase military construction program. The ground-breaking for the initial phase of this construction is slated to start in early CY93. SYSTRAN believes a major void to the successful and efficient implementation and operation of the AWT is that of a software system that will support AWT users in the selection, composition, and application of the individual hardware and software "components" (i.e., subsystems, modules, packages, processors, etc.) into a AWT instance that most appropriately fits the needs of an AWT customer. SYSTRAN proposes, in Phase I, to specify and design a (top-level) Meta-System Application to fill this AWT void. In Phase II this Meta-System Application would be developed and demonstrated.

SYSTRAN CORP.
4126 LINDEN AVENUE
DAYTON, OH 45432
Phone: (513) 252-5601
Topic#: 93-158
Office: XRX
Contract #: F33615-93-C-1299
PI: Mr. George J. Valentino
ID#: 93XRX-122
Title: Gigabit Multi-media Network for Avionics Wind Tunnel
Abstract: SYSTRAN proposes, in Phase I, to assess the gigabit (i.e., video) communication needs of the WL/AAS Avionics Wind Tunnel (AWT) and formulate the top-level functional specifications and implementation plan required to (in Phase II) prototype, produce, and implement a WL/AA-wide Gigabit Multi-media Network that responds to these requirements. We understand that WL/AAAS has real-time network requirements across several domains - data, voice, video, and RF. SYSTRAN is pleased that all SCRAMNet (Shared Common RAM Network) is being considered as the real-time network solution for the "data" domain. During the last seven years, SYSTRAN has successfully transferred the underlying technology used in SCRAMNet - Shared Memory Network (SMN) technology (developed by WL/AA) - into a successful commercial product. As part of our participation in, and contribution to, many SMN applications, SYSTRAN designers and engineers have become extremely knowledgeable about the entire family of network technologies. There are several emerging networking technologies. FFOL (FDDI Follow ON LAN), FC (Fibre Channel), SCI (Scalable Coherent Interface), and ATM (Asynchronous Transfer Mode) are the leading technologies to date. Choosing the right network for the future is difficult because of the many options. SYSTRAN offers to WL/AAAS their experience in mapping the needs of the Lab against the best emerging network technologies. We believe that the use of ATM (Asynchronous Transfer Mode) switch technology provides the optimum solution to AWT gigabit video communication requirements, such as complex and sophisticated simulations including real-time intelligence in the cockpit. Our Phase I program will provide WL/AAAS with the best options and alternatives for gigabit network communications with the AWT (and throughout Bldg 620 and WPAFB, Area B).

SYTRONICS, INC.
1656 MARDON DRIVE
DAYTON, OH 45432
Phone: (513) 429-1466
Topic#: 93-160
Office: XRX
Contract #: F33657-93-C-2440
PI: Barbara Kay McQuistion
ID#: 93XRX-046
Title: More Supportable T-38A Enhancement Study
Abstract: SYTRONICS proposes to investigate ways to decrease the time required to maintain the T038A between training flights. The T-38A still fills the Air Forces's Bomber Fighter training needs, and system upgrades being completed under Northrop's PACER CLASSIC Program to help keep the aircraft technologically up-to-date. SYTRONICS' maintenance study can ensure that the T-38A will serve as an efficient, reliable trainer into the 21st century and beyond. The key to SYTRONICS' effort is the data provided by Northrop's Supportability Technology Development Center. Northrop built the T-38 and has collected large amounts of data (ranging from 1972 data to current, real-time CAMS data) on all aspects of T-38 maintenance. In addition to Northrop's recorded data, SYTRONICS will also be able to call on Northrop personnel who maintained the T-38 while serving in the Air Force. This first-hand experience will be invaluable to SYTRONICS' study. Possible maintenance improvements produced by the Phase I study will become specific recommendations for Air Force action during Phase II. In Phase III, SYTRONICS will develop a procedural prototype for T-38A maintenance.

T/J TECHNOLOGIES, INC.
17445 CAMERON
NORTHVILLE, MI 48167
Phone: (313) 347-0305
Topic#: 93-180
Office: WL0
Contract #: F08630-93-C-0048
PI: Michael Wixom
ID#: 93WL0-220
Title: High Surface Area Nitride Films for Electrolytic Capacitors
Abstract: Recent developments in catalyst technology have led to new routes for the preparation of high surface area (HSA) early transition metal nitrides. These materials have physical and chemical properties which make them interesting candidates for use as electrodes in high energy density electrolytic capacitors. Among the properties of interest are electrical conductivity, chemical stability, and thermal stability. In this proposal we will explore the feasibility of adapting catalyst preparation techniques to produce a laboratory prototype capacitor based on HSA molybdenum nitride anodes. High surface area molybdenum nitride anodes will be prepared via the topotactic reaction of the oxide with NH3 . The dielectric oxide layers will be formed by anodization and solid electrolytes will be used in the Phase I laboratory prototype. Electrical evaluation will include determination of capacitance, effective series resistance, leakage current, energy storage density, and temperature stability. During the course of this research the materials will also be examined to determine their surface areas (gas absorption), surface morphologies (SEM), and film thicknesses (Rutherford backscattering spectroscopy). The Phase II program will emphasize materials optimization and packaging design.

TACAN CORP.
2330 FARADAY AVENUE
CARLSBAD, CA 92008
Phone: (619) 438-1010
Topic#: 93-016
Office: AFOSR
Contract #: FQ8671-9301303
PI: James H. Bechtel
ID#: 93AFO-005
Title: High-speed Electro-optic Modulators
Abstract: The objective of this work is to use advanced multifunctional polymers for ultra-high speed, electro-optical modulation modules. For electro-optic modulators, polymer-based devices can gave large electro-optic coefficients, small dispersion, larger frequency response, and greater fabrication flexibility compared to titanium undiffused LiNbO3 or GaAs waveguide technology. Throughout the work we will emphasize the design of non-linear optical materials which simultaneously address multiple requirements such as waveguide formation and optical non-linearity. We will evaluate new materials for properties such as non-linear optical (Pockels') coefficients, indices of refraction, optical absorption, optical scattering, photobleaching index of refraction change, RF dielectric constant, as well as chemical stability, mechanical properties, and thermal properties. We will also determine the suitability of various candidate polymers for application to external modulation devices. This determination will concern materials handling and processing, damage threshold, environmental stability, and service life. A prototype modulator will be constructed and tested to demonstrate the use of multifunctional polymers materials for optical modulation and analog data links during Phase II. The use of multifunctional polymer materials will provide improved frequency response (potentially to 100 GHz), larger electro-optic effect, large damage threshold, lower cost, and greater manufacturing flexibility.

TAITECH, INC.
3675 HARMELING DRIVE
BEAVERCREEK, OH 45440
Phone: (513) 255-8705

Topic#: 93-152 ID#: 93WL6-020
Office: WL6
Contract #: F33615-93-C-2313
PI: DR TZONG H. CHEN

Title: Joint Two-dimensional Droplet/Gas Velocity Mapping for Supersonic Ramjet Applications

Abstract: The thrust of the proposed research is to research and develop a 2-D joint measurement scheme for simultaneously measuring the droplet and gas velocities to enhance the understanding of the droplet-turbulence interactions. A Particle Image Velocimeter (PIV) for measuring the droplet velocity will be jointly implemented with an OH-Flow-Tagging Velocimeter for measuring the gas velocity. The proposed 2-D measurement technique is suitable for the operation conditions of high temperature and high level of vibration typically encountered in shock tunnel and ramjet research facility. For the routing operation of the above system, the re-calibration is not required and the system maintenance is minimum. The hardware and software associated with this system can also be converted for the 2-D measurement of species concentration, density, and temperature. The research and development of such a system will make a useful contribution to the study of supersonic fuel injection involving multiple phases and their interaction mechanisms.

TANNER RESEARCH, INC.
180 NORTH VINEDO AVENUE
PASADENA, CA 91107
Phone: (818) 792-3000

Topic#: 93-026 ID#: 93AL -131
Office: AL
Contract #: F41624-93-C-6012
PI: Dr. Massimo Sivilotti

Title: Analog CMOS Neural Circuits for Speech Recognition

Abstract: In order to become a feasible human interface technology suitable for operational deployment, real-time speech recognition requires orders-of-magnitude improvement in processing capability and an affordable implementation. We are currently developing analog CMOS speech recognition chips combining integrated silicon cochleae and neural networks based on auditory system modeling. We have demonstrated a prototype version of our low-precision highly parallel analog neural network in the laboratory. Under NSF funding, we will continue to research and develop these massively parallel custom integrated circuits that will perform recognition of speaker-independent connected speech, using integrated delay lines and analog computing networks. During this Phase I, we propose to investigate robust speech processing as an intuitive interface to relieve crew work load and enhance crew safety. We will develop the performance specifications required for a speech system to solve a real Air Force human factors problem. We will also capture representative speech data, experiment with recognition of the data, and prepare for the Phase II effort to deploy a full-scale prototype speech recognition system based on our custom integrated circuits. This effort serves to focus our advanced neural network research on an important real-world problem and may lead directly to inexpensive products with wide commercial applicability.

TANNER RESEARCH, INC.
180 NORTH VINEDO AVENUE
PASADENA, CA 91107
Phone: (818) 792-3000

Topic#: 93-117 ID#: 93WL3-026
Office: WL3
Contract #: F33615-93-C-1261
PI: Massimo A. Sivilotti

Title: Application Specific Electronic Design Synthesis: Neural Network Silicon Compiler

Abstract: Future weapon systems require significant advances in computing systems scale and functionality. Neural networks hold considerable promise to deliver very high performance and powerful new capabilities, as well as compact physical size, low power and high reliability. Such electronic neural networks are very attractive to system developers. To date actual systems incorporating electronic neural networks have been limited (and expensive), due to a lack of flexibility in constructing custom network architectures with the available hardware modules. We propose to develop electronic design synthesis tools for constructing custom integrated circuits that implement application-specific neural networks. These tools will assist the application engineer in selecting between broad classes of analog and digital implementation technologies, architectures, interconnect topologies, interfaces, and permit direct circuit synthesis of manufacturable integrated circuits. The tools would also interface to simulators and development systems, to assist the designer in validating the neural network using experimental and training data. In Phase I, we will prove the tools by fabricating demonstration circuits built on existing Tanner Research technology. Our approach will utilize commercial integrated circuit technology. Products arising from this R&D can be fabricated reliably and economically by a number of vendors.

TANNER RESEARCH, INC.
180 NORTH VINEDO AVENUE
PASADENA, CA 91107
Phone: (818) 792-3000
Topic#: 93-164 ID#: 93WL0-044
Office: WL0
Contract #: F08630-93-C-0030
PI: Andrew Moore, Ph.D.
Title: High Speed Image Filtering for Armament Research
Abstract: The dynamic range of modern image sensors can exceed the range of a video monitor by an order of magnitude or more. This means that fast arid intelligent range compression and image enhancement must be interposed between the sensor and display for effective surveillance, target acquisition, and intelligence gathering. Digital hardware can enhance an image in real time, but the common method for range compression on digital hardware, linear filtering, can severely distort the image. We propose to evaluate designs for high-speed image range compression chips. At Tanner Research, image processors are under development that carry out non-linear filtering for range compression and image enhancement at video rates. The non-linear filtering intelligently compresses the range without distortion. We will prepare a design that increases processing speed by an order of magnitude, to 500-1000 frames per second, in the Phase I effort. We will measure the performance limits of the existing processor; results will guide in the design task. In Phase II, we will fabricate and test the high-speed processor technology.

TAYLOR DEVICES, INC.
90 TAYLOR DR.
NORTH TONAWANDA, NY 14120
Phone: (716) 694-0800
Topic#: 93-070 ID#: 93PL1-051
Office: PL1
Contract #: F29601-93-C-0095
PI: DOUGLAS P. TAYLOR
Title: Missile Payload Vibration Isolation
Abstract: Isolation systems are used on spacecraft to reduce structural loadings from shock and vibration during launch. The launch environment includes both step-like acceleration and random vibration as a combined input. This requires a cumbersome high displacement isolation system when conventional passive spring and damping elements are used. Prior research using active isolation with force drivers has predicted improved performance, but high power requirements and the need for complex sensor systems presents a substantial problem for spacecraft use. This proposal describes an improved isolation system, using semi-active controls, where essentially passive spring and damping elements have their output parameters varied by the control system. This semi-active isolator is both simple and reliable, requiring a minimum of sensors for excellent performance. The design is also inherently fail safe, reverting to passive operation as a redundant operating mode. Computer simulation results are provided, comparing the semi-active isolator with comparable active and passive types. The simulation demonstrates the superiority of the semi-active device. The simulation code is PC based, and is capable of studying all known launch environments, and can be used to select isolator parameters for present and future isolation applications.

TDA RESEARCH, INC.
12345 WEST 52ND AVENUE
WHEAT RIDGE, CO 80033
Phone: (303) 422-7953
Topic#: 93-151 ID#: 93WL6-216
Office: WL6
Contract #: F33615-93-C-2335
PI: MICHAEL E. KARPUK
Title: High Thermal Conductivity Catalysts for Endothermic Fuel Reactions
Abstract: Aircraft designed for flight in the Mach 3-6 range must incorporate active cooling in the turbo-ramjet propulsion system. The required cooling can be provided by endothermic reactions of the fuel prior to its combustion. Endothermic fuel reactions require a catalyst. Previously developed catalysts for endothermic fuel reactions are supported on low thermal conductivity materials which makes it difficult to heat the catalysts. Consequently, heat transfer to the catalyst is a major problem in the design of endothermic fuel reactors. TDA Research proposes to investigate new catalysts for endothermic fuel reactions. These catalysts have very high thermal conductivity as well as the potential for lower cost and better high-temperature stability then previously developed catalysts.

TDA RESEARCH, INC.
12345 WEST 52ND AVENUE
WHEAT RIDGE, CO 80033
Phone: (303) 422-7819
Topic#: 93-157 ID#: 93WL6-104
Office: WL6
Contract #: F33615-93-C-2368
PI: DAVID T. WICKHAM

142

Title: Tracer for Early Detection of Underground Fuel Spills
Abstract: Leaking underground fuel storage tanks must be rapidly detected to minimize cleanup costs. TDA research, (TDA) has identified a class of tracer compounds that allow the rapid detection of leaks. The tracer extracts from spilled fuel into the groundwater, moves quickly through the soil, and is easily detected before leakage of fuel becomes a serious problem. The tracers are save, compatible with existing fuel systems, and have extremely low limits of detection: we estimate that a 10,000 gallon tank will require as little as one gram of the tracer. The detection method allows for a simple, solid-state, field-portable instruments, which speeds analysis and lowers the cost of the system. TDA has identified a family of similar but distinguishable tracers, so that a leak can be traced to a particular tank. In Phase I, TDA will test candidate tracer materials to establish their limit of detection, measure their fuel/water partition coefficient, demonstrate their rapid transport through soil, and define the overall system performance and projected cost. In Phase II we will carry out tests to assure fuel system compatibility, design, construct, and test the field-portable tracer detection system, and begin field tests.

TECHNICAL RESEARCH ASSOC., INC.
2257 SOUTH 1100 EAST
SALT LAKE CITY, UT 84106
Phone: (801) 485-4994
Topic#: 93-096 ID#: 93PL3-058
Office: PL3
Contract #: FO4611-93-C-0095
PI: Dr. Jared Lee Sommer
Title: High Emissivity Arcjet Thruster Anodes
Abstract: High-power ammonia arcjet thrusters are being investigated as primary propulsion systems for carrying satellites into high altitude orbits. As a method to enhance the power levels and efficiency of the engine, the thermal emissivity of the outer anode surface must be substantially enhanced. Ideally, the anode material should be low density, both highly electrically and thermally conductive, and be chemically compatible with the reactive propulsion gases. The proposed research will investigate anode materials fabricated from directionally aligned carbon/carbon (C/C) composite. The inside surfaces of the plenum chamber, constrictor throat, and expansion nozzle will be coated with a layer of conductive tungsten metal to serve as the arc attachment surface, to protect the C/C composite surface and to ensure effective radiation of the heat flux generated by the arcjet plasma.

TECHNICAL RESEARCH ASSOC., INC.
2257 SOUTH 1100 EAST
SALT LAKE CITY, UT 84106
Phone: (801) 485-4994
Topic#: 93-187 ID#: 93WL9-049
Office: WL9
Contract #: F33657-93-C-2235
PI: Joseph K. Weeks
Title: Carbon/Carbon Composites with Refractory Metal Tubes Formed In situ for Improved Heat Transfer
Abstract: In the next generation of air-breathing high-performance engines, significant engine performance improvements are envisioned by combusting hydrogen with air in a regeneratively cooled carbon/carbon composite combustion chamber. Surfaces subjected to aerodynamic heating will also be cooled by recirculating hydrogen through cooling tubes. To date, approaches investigated have not had desired levels of heat transfer. In the Phase I program, two approaches to providing high heat transfer between cooling tubes and the C/C composite will be investigated. In the first, holes machined in the composite will be lined with a refractory metal liner using a proprietary process which provides good bonding between the metal liner and the composite. The process should completely fill any cracks or pores in the C/C composite. In the second approach, metal alloy tubes will be placed in refractory metal lined holes in the C/C composite. The gap between the tubes and the lined holes will be filled with copper or other non-reactive brazing metal. Filling the gap with high-conductivity metal should increase heat transfer to desired levels. Samples will be tested for hydrogen leakage, resistance to thermal cycling and resistance to high heat fluxes. The data developed in Phase I will lead to the design and operation of a prototype heat exchanger in Phase II.

TECHNIWEAVE, INC.
109 CHESTNUT HILL ROAD
ROCHESTER, NH 03868
Phone: (603) 335-2115
Topic#: 93-185 ID#: 93WL9-029
Office: WL9
Contract #: F33657-93-C-2228
PI: Jean Francois Lecostaouec
Title: Integrally Woven Lightweight High Temperature Structures
Abstract: A new textile process has been developed by Techniweave that employs multidirectional weaving in the fabrication of integrally woven, net shaped, complex components. The process has been demonstrated manually and has been shown

through design of equipment to be feasible for an automated system. The process offers several attributes which are not, in combination, available with any other process. Cross rib-stiffened preforms have been woven by Techniweave, Inc. using carbon fibers with the ribs integrally woven with the panel(skin). Quasi-isotropic fiber orientation was used in both the panel and ribs which can be varied to suit the designers requirements. Z-direction reinforcement was introduced without damage to fibers. Similar methods can be used to fabricate other ceramic fiber preforms. Techniweave proposes to demonstrate the innovative concept through the fabrication of carbon fiber preforms that will be densified with a carbonaceous matrix by B.F.Goodrich Super-Temp. The quality of the composite will be evaluated through preliminary mechanical properties and compared to the state of the art in carbon-carbon composites. Further consideration will be given to the design and feasibility of automated equipment that can handle brittle fibers such as carbon and other ceramic fibers. A recommendation will be made with respect to a Phase II program.

TECHNOLOGY RESEARCH ASSOC.
1525 ESPINOSA CIRCLE
PALO VERDES ESTAT, CA 90274
Phone: (310) 378-8098
Topic#: 93-081 ID#: 93PL1-072
Office: PL1
Contract #: F29601-93-C-0062
PI: MARVIN M LITVAK, Ph.D.
Title: Transport-equation Digital Image Correction System
Abstract: Ground-based visible and infrared imaging of distant objects is hampered by the distortions due to the atmosphere, so that the angular resolution that ground-based and airborne telescopes are capable of are seldom achieved on a real-time basis. However, the Transport-Equation Digital Image Correction system is a full-correction (amplitude and phase) innovation that is optically and electronically simpler, less expensive, and more sensitive to beacons or to self-calibrating extended objects than conventional means. Pairs of slightly defocussed images are processed at millisecond rates for amplitude as well as the usual phase information. Through the energy transport-equation technique and through feedback of correction for speckle, clear images are real-time, digitally reconstructed without the deformable mirror of conventional adaptive optics. Phase I is to expertly develop a computer simulation of the real-time system to test the algorithms and to design the pre-prototype system for integration and testing in Phase II.

TECHNOLOGY SERVICE CORP.
2950 31ST STREET, SUITE 200
SANTA MONICA, CA 90405
Phone: (310) 450-9755
Topic#: 93-042 ID#: 93ES3-007
Office: ES3
Contract #: F19628-93-C-0125
PI: Charles A. Shipley
Title: Element Failures in Adaptive Antenna Arrays
Abstract: Solid state active phased array antennas promise to provide very low sidelobe capability. However, they will be subject to short term calibration drift and element failures. This compels an on-line, operational self calibration capability. TSC proposes a completely internal, on-line self calibration technique which utilizes the inherent mutual coupling among the radiating elements to accurately measure the transfer coefficients of each of the elements and their associated T/R module receivers and transmitters, transmission lines, and beamformers. The technique does not require knowledge of the absolute magnitude of the mutual coupling coefficients, but exploits the fact that the coupling coefficients will be very consistent across the array, and will remain very stable with time. Once the transfer coefficients are accurately measured, the appropriate corrections are applied to the T/R module phase shifters and attenuators. In case of a failed element, one of several algorithms is applied which optimally adjusts the other elements in the array to recover the antenna pattern sidelobe performance. The simplest of these to implement utilizes adjustments to the weights of the other elements in the array to synthesize, and add back, a close approximation of the missing array element pattern.

TECHNOLOGY SERVICE CORP.
2950 31ST STREET, SUITE 200
SANTA MONICA, CA 90405
Phone: (310) 450-9755
Topic#: 93-115 ID#: 93WL2-117
Office: WL2
Contract #: F33615-03-C-1263
PI: Mr. Joseph Salzman
Title: Active Expendable Electronic Counter-countermeasures (ECCM)
Abstract: The advent of technology (e.g., GaAs MMIC amplifiers and DRFM devices) has enhanced the development of inexpensive expendable repeater/transponder jammers that can mimic an airborne radar's signal coherently, and modulate it to

deceive, confuse or obfuscate the radar/receiver, effectively preventing it from achieving or maintaining track lock-on, thus delaying or precluding missile launch. The proliferation and availability of these inexpensive active expendables throughout the world makes them a viable threat to US airborne intercept (AI) radars. Technology Service Corporation (TSC) proposes to assess two ECCM techniques to counter the effects of ECM signals generated by active expendables during an airborne radar track mode, while minimizing the impact on the radar system. The two techniques--Target Modulated ECCM (TAME) and Multiple Target Angular Resolution (MTAR) complement each other--and together will counter ECM wave forms expected from active expendables in general, and towed decoys in particular. TAME (a TSC-proprietary technique) is primarily effective against coherent repeater signals (false targets or pull-offs), but not against narrowband repeater doppler noise; whereas MTAR is most effective against narrowband repeater doppler noise, as well as against repeater signals in the same resolution cell as the protected target (i.e., prior to pull-off). Phase I study tasks consist of assessing current and postulated future ECM parameters of active expendable jammers, developing the ECCM algorithms, and analyzing the ECCM techniques performance and feasibility. A plan to test the ECCM techniques via simulation during Phase II will be developed during Phase I.

TECHNOLOGY SERVICE CORP.
2950 31ST STREET, SUITE 200
SANTA MONICA, CA 90405
Phone: (310) 450-9755

Topic#: 93-116
Office: WL2
Contract #: F33615-93-C-1245
PI: Dr. Robert Koda

ID#: 93WL2-096

Title: Automatic Target Recognition (ATR) Research Validation of Synthetic Target Signatures (Topic I)

Abstract: In the proposed program, TSC will evaluate candidate synthetic radar signature validation techniques. The objective is to provide the Air Force with a procedure for evaluating model-validation metrics for radar models used in developing Non-Cooperative Target Recognition (NCTR) techniques and algorithms. The methodology is to use the metric's classification performance against generic NCTR algorithms such as Adaptive Neural Nets and Bayesian classifiers to obtain a quantitative measure of each metric's performance as a prediction of NCTR effectiveness. The metric will be obtained with model fidelity as a parameter. Metrics will include statistical methods such as the Kolmogorov-Smirnov test and various correlation techniques. Preliminary validation analysis will be performed for representative targets at representative aspects using TSC's radar Imagery Generator (RIG) as the primary software platform. Extended analysis will be performed in the Phase II follow-on effort over a more extensive data base.

TECHNOSOFT, INC.
WAYCROSS SO., 431 OHIO PIKE, SUITE 100
CINCINNATI, OH 45155
Phone: (513) 528-9149

Topic#: 93-158
Office: XRX
Contract #: F33657-93-C-5360
PI: Adel Chemaly

ID#: 93XRX-112

Title: Concurrent Design and Process Planning for Rapid Production of Custom Design Parts using Knowledge Based Engineering

Abstract: Custom design parts for sophisticated Air Force weapon systems are produced in small batches, where the design and plan process account for a large percentage of the development and production time. The production cost per part is higher for single or batch production when compared to mass production. In batch production, the machining time does not account for a large percentage of the total time for designing, planning, and production. Therefore, for cost optimization, it is more important to cut down the planning time by quickly generating a feasible process plan rather that the lengthy generation of an optimized plan. The emphasis is on short turnaround time for immediate prototyping. For mass production it is important to optimize the process plan to minimize the machining time. The proposal objectives are to automate the design and manufacture plan of custom parts by developing a concurrent engineering system with geometrical reasoning engine, for integrated design, part specifications, and process planning. In Phase I, the architectures of the system will be completed. A limited prototyping system will be developed. In Phase II, the system development will be completed and tested in real production. Also, a plan to commercialize the system will be prepared.

THE PLS GROUP
11325 SEVEN LOCKS ROAD, SUITE 226
POTOMAC, MD 20854
Phone: (301) 983-8508

Topic#: 93-029
Office: AL
Contract #: F41624-93-C-5007
PI: Donna S. Sullivan

ID#: 93AL -191

Title: Simulation Authoring Tool for Technical Training
Abstract: We propose the development of a cost-effective simulation authoring capability to augment efforts to develop an intelligent instructional design advisor to be used by subject matter experts with little formal training in instructional technology. Capabilities to be considered for Phase II implementation include: ability to mix interactive text, graphics, music, digitized sound, CD-ROM audio, branching, record keeping, animation and the system will deliver highly realistic real time, on-line training. Looking toward a Phase II, we will specify a system capable of delivering fully integrated, real time multi-media in a captivating presentation mode. Thus, user-students will be able to sustain their concentration while learning complex cognitive concepts. Through the use of object-oriented design, the system will allow a user to develop courseware that previously required the skill of programmers, instructional designers, subject matter experts and graphic designers. Courseware development costs will be dramatically reduced with this system. Delivery of the instructional design approach will take advantage of the power and flexibility of the system. With the advances in the 80386-80486 environment and those anticipated in the much-talked about 80586 environment, the speed of the system is in itself an advantage in maintaining student interest.

THE ULTRA CORP.
110 HARTWELL AVE
LEXINGTON, MA 02173
Phone: (617) 863-2088

Topic#: 93-035
Office: ES3
Contract #: F30602-93-C-0146
PI: Donald M. Leskiw

ID#: 93ES2-239

Title: High Performance Computing for C3I Computational Electromagnetics Applications
Abstract: This proposed effort will accomplish advanced development, i.e., systematic application of tools and techniques, of technology for high performance computing. The first phase will provide the proof-of-concept of a new technology: High Performance Geometric Theory of Diffraction (HPGTD) for complex systems. This HPGTD technology will be developed and demonstrated using portions of an existing Rome Laboratory (RL/ERPT) conventional scattering code, GEMACS, for General Electromagnetic Model for the Analysis of Complex Systems. Phase II will complete the development of HPGTD, use it to parallelize the rest of the GEMACS GTD software, and deliver and document the new code for production use. The resulting HPGTD software will be scalable and portable to massively parallel processors, but also regress to serial execution on a single processor for baseline validation.

THERMACORE, INC.
780 EDEN ROAD
LANCASTER, PA 17601
Phone: (717) 569-6551

Topic#: 93-096
Office: PL3
Contract #: FO4611-93-C-0097
PI: William G. Anderson

ID#: 93PL3-026

Title: High Emissivity Surface Treatments for Arcjet Thrusters
Abstract: Most surface emissivity coatings exhibit adherence problems under severe operating conditions of an arcjet. A porous surface produced from powdered tungsten would more than double the effective emissivity, and would maintain full metallurgical integrity with the tungsten anode. Certain coatings, specifically hafnium carbide, appear promising and will be investigated. Combining hafnium carbide with porous tungsten could produce an effective emissivity in excess of 0.98.

THERMACORE, INC.
780 EDEN ROAD
LANCASTER, PA 17601
Phone: (717) 569-6551

Topic#: 93-146
Office: WL6
Contract #: F33615-93-C-2324
PI: NELSON J. GERNERT

ID#: 93WL6-071

Title: Improved Flexible Heat Pipe Cold Plate Technology for Aircraft Control
Abstract: The innovation is the incorporation of capillary pumped loop (CPL) heat pipe technology into Thermacore developed Flexible Heat Pipe Cold Plate (FHPCP) hardware. Thermacore has successfully designed, fabricated, and tested four FHPCP geometries for four different aircraft applications. The results, compiled in a report and submitted to the Naval Air Development Center, demonstrated the FHPCP's versatility and capacity for cooling. The report also indicated that substantial progress had been made towards qualifying the FHPCP for aircraft use; however, additional tests were recommended to complete this work. The suspected weakness (and area of needed testing) of the original FHPCP design was performance under adverse high-g loading and adverse elevation. A CPL design features inherently improved performance under these adverse conditions; consequently, the proposed program would use a CPL design to improve the FHPCP's performance and possibly qualify the

advanced design for aircraft use. In addition, the program would pursue additional aircraft cooling applications as well as investigate lighter materials of construction.

THOUGHTVENTIONS, INC.
P.O. BOX 1310
GLASTONBURY, CT 06033
Phone: (203) 657-9883

Topic#: 93-092 ID#: 93PL3-028
Office: PL3
Contract #: F04611-93-C-0086
PI: Stephen C. Bates

Title: Prototype Cryogenic Solid Hydrogen Storage and Pellet Injection System for Combustion

Abstract: Liquid hydrogen is currently the fuel of choice for large-thrust propulsion systems because its high specific impulse more than compensates for its low density. Although more energetic fuels have been shown to exist through projects such as the Air Force High Energy Density Materials Program, these fuels are unstable enough to not yet be practical. It has been proposed to add these energetic materials to cryogenic solid molecular hydrogen to form a stable, superior-performance fuel. Solid cryogenic propellants may even emerge as an important part of what the American Space Exploration Initiative has recently recognized as the critical national technology of cryogenics. Based on the technology of pellet fueling of fusion plasmas, this proposal first describes the design of a prototype solid hydrogen propellant system for combustion studies. The hydrogen is condensed directly into a solid, extruded, formed into pellets, and injected into a combustion chamber. The primary remaining feasibility issues of such a system: pellet interaction with combustion, rapid solid condensation from a gas, and the development of a high feed rate injector, will also be addressed. The proposed work is expected to provide the basis for a practical solid hydrogen rocket propulsion system.

TOP-VU TECHNOLOGY, INC.
2650 14TH STREET, NW
NEW BRIGHTON, MN 55112
Phone: (612) 633-5925

Topic#: 93-106 ID#: 93PL6-035
Office: PL6
Contract #: F04704-93-C-0015
PI: Tho T. Vu

Title: Parallel and Pipeline Architecture for Guidance and Navigation GaAs Signal Processors

Abstract: Top-Vu's unique approach is to combine the parallel pipeline processing architecture and the gallium arsenide (GaAs) very large scale integrated (VLSI) circuit technology that offers several order of magnitude performance improvements to guidance and navigation signal processors. The parallel pipeline processing architecture is to reduce the power, weight, size, and cost, while meeting high performance with the use of GaAs architecture. The GaAs VLSI technology is used for high speed, low power and high radiation tolerance. Top-Vu addresses the cost and performance improvements by making the advanced component technology, processor technology and system architecture work together. The primary application of this project is for the Air Force ICBM Guidance and Navigation Signal Processors. For the Phase I, we will identify and develop specific functional elements of the infrared sensor signal and data processing chain. The technical objectives of the Phase I 6 months project are to: 1) identify functional elements, 2) devise a GaAs chip architecture, 3) design functional elements, 4) develop GaAs digital circuits, and 5) estimate the processor performance. The proposed GaAs processor is also applicable to data from other sensors such as inertial, electro-optic, radar and sonar.

TOYON RESEARCH CORP.
75 AERO CAMINO, SUITE A
GOLETA, CA 93117
Phone: (805) 968-6787

Topic#: 93-125 ID#: 93WL4-093
Office: WL4
Contract #: F33615-93-C-3605
PI: Mr Harold I. Jackson

Title: Fighter Cockpit Precision Cursor Control

Abstract: The objective of the proposed effort is to determine the potential benefits and performance in using head rotation to precisely control the cursor on a display. We will design, develop, and test a scheme that uses a laser to read a bar pattern inscribed on the pilot's helmet. Head rotations modulate the reflected energy, and these are translated into cursor movement. The device is functionally identical to the mouse used in many personal computers. This program includes extensive analysis of pilot's tasks to understand when, how, and to what precision he executes cursor positioning tasks. The Phase I study objectives are to establish the engineering feasibility of the device and to assess its potential benefit and suitability for the tasks and environment of the single-seater fighter cockpit.

TOYON RESEARCH CORP.
75 AERO CAMINO, SUITE A
GOLETA, CA 93117
Phone: (805) 968-6787

Topic#: 93-158
Office: XRX
Contract #: F33657-93-C-2299
PI: Joel R. Garbarino

ID#: 93XRX-049

Title: Innovative Analysis Tool for Developing Aeronautical Systems to Counter Tactical Relocatable Targets

Abstract: The DESERT STORM experience generated a sudden and intense interest in tactical missile launchers. Our impotence in finding and destroying these launchers soon became obvious to us as well as the rest of the world. Later it became apparent that we also lacked the analysis tools needed to investigate and develop effective responses to missile launcher and other Critical Mobile Targets (CMTs). A three-phase program is described here for developing a simulation tool which can be used by the Aeronautical Systems Center (ASC) to investigate candidate approaches and perform tradeoff studies to develop the requirements for airborne platforms capable of countering mobile missile launchers and other CMTs. The simulation will use the same innovative approach applied by Toyon in support of DARPA's sensor development efforts, but will be structured to focus on the issues relevant to sensor platforms rather than sensors. Phase I, the principal subject of this proposal, will focus on demonstrating the feasibility of creating the desired simulation. Phase II, as a follow-on to Phase I, will proceed with full-scale development of a complete and user-friendly simulation which ASC can use to explore the tradeoffs between various platforms and the relevant parameters for countering CMTs. A final phase, funded by commercial interests, would make further refinements in the simulation, possibly including the creation of new versions which could be hosted on other types of machines of interest to industry.

TPL, INC.
3754 HAWKINS NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-5668

Topic#: 93-091
Office: PL3
Contract #: F04611-93-C-0081
PI: Robert D. Chapman

ID#: 93PL3-008

Title: Novel Synthesis of Cubane Precursors

Abstract: The most important objective of the Phase I program is to identify an improved preparation of a cubane derivative, preferably a cubanedicarboxylate derivative. The innovative routes proposed herein will demonstrate a synthesis of cubanedicarboxylic ester possibly in two steps - from a commercial starting material - based on sound fundamental principles or with a novel reaction sequence involving three steps based on analogous literature precedence for each step. Preparations of tailorable cubane derivatives with four substituents (all equivalent or two different pairs) - and possibly up to eight equivalent ones - should be possible in only two additional steps besides two key transformations necessary for formation of any cubane skeleton. All schemes proposed should offer significant improvements in the practicality of preparing desirable cubane derivatives.

TPL, INC.
3754 HAWKINS NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-5668

Topic#: 93-175
Office: WL0
Contract #: F08630-93-C-0043
PI: H.M. Stoller

ID#: 93WL0-167

Title: A Metallic Fuel-reinforced Explosive for Improved Mechanical properties

Abstract: Explosives with improved mechanical properties are needed in high performance penetrator warheads to overcome the degradation effects of the impact-generated stress waves on explosive performance. The use of the metallic fuel, either in fiber or open-cell foam form, as a reinforcement agent is proposed. Several metallic fuel elements are available in such forms with high mechanical properties where significant reinforcement effects can occur. Effective load transfer between explosive binder and metallic fuel element to achieve this reinforcement effect will be obtained through the use of a bifunctional reactive primer. In Phase I explosive requirements will be established and a mock explosive selected and mechanically characterized. Processing studies and mechanical characterization tests will be performed on reinforced mock explosives. Explosive performance will be modeled. One real reinforced explosive will be manufactured with spall strength and explosive performance measured. TPL, with its knowledge of energetic materials and composite materials, has the capability to achieve program objectives. Its association with the Energetic Materials Research and Testing Center, New Mexico Tech provides access to explosive manufacture and testing facilities.

IKB

TRIFID CORP.
680 CRAIG RD., SUITE 308
ST. LOUIS, MO 63141
Phone: (314) 991-3095

Topic#: 93-035 ID#: 93ES2-007
Office: ES2
Contract #: F19628-93-C-0144
PI: Dr. Marshall Faintich

Title: Enhanced Mission Support System Planning Graphics for Tactical and Special Forces Operations

Abstract: A variety of mission planning scenarios rely on the mission support system to have the ability to produce simulated perspective scenes of the theater of operations of interest. These simulated scenes range from low to medium altitude vertical and oblique scenes for actual operations. The purpose of this proposal is to offer a new and innovative technique for the creation of realistic mission planning scenes based upon geospecific orthorectified photo-texture and terrain data bases that can be manipulated to reflect the atmospheric weather conditions and time of day of the mission.

U.S. LASER CORP.
825 WINDHAM COURT N., P.O. BOX 609
WYCKOFF, NJ 07481
Phone: (201) 848-9200

Topic#: 93-178 ID#: 93WL0-211
Office: WL0
Contract #: F08630-93-C-0081
PI: Carl B. Miller, Jr.

Title: Fiber Optic System for Delivery of High Power Laser Radiation

Abstract: The Air Force is developing an ROD system utilizing a high power laser to neutralize unexploded ordnance. The system is called the Mobile Ordnance Disrupter System (MODS). The current design requires a clear line-of-sight from the vehicle to the ordnance, and thus is ineffective against munitions in depressions, behind obscurations or in buildings. A fiber optic beam delivery system (FOBD) offers an alternative approach in these cases. However, in its present state of development, FOBD is not suitable for MODS, due principally to problems with fiber damage, power loss, and output beam formation. This study will focus on assessing currently available technologies, and identifying additional requirements to overcome these deficiencies, so that a FOBD system for MODS becomes technically and economically feasible. Propagation of high power laser radiation through optical fibers of various types and sizes will be evaluated through mathematical modelling and laboratory experiments. The current state-of-the-art on other components of FOBD will be assessed. Low loss transmission of energy from a 1000 CW Nd:YAG laser through a FOBD system will be demonstrated. Other potential applications of FOBD in the MODS vehicle will be evaluated.

UES, INC.
4401 DAYTON-XENIA ROAD
DAYTON, OH 45432
Phone: (513) 426-6900

Topic#: 93-136 ID#: 93WL5-100
Office: WL5
Contract #: F33615-93-C-5331
PI: Dr P R Subramanian

Title: Fabrication of Metal Matrix Composites by Physical Vapor Deposition of Matrix Material on Ceramic Fibers

Abstract: UES is proposing a novel vapor synthesis route for producing MMCs in which the matrix alloy will be directly deposited on reinforcing fibers by magnetron sputtering under UHV conditions. A post-deposition consolidation will be used to fabricate MMC's directly from the matrix-containing fibers. This fabrication route offers the following advantages: (a) a very clean environment with excellent impurity control, (b) good repeatability/reproducability, (c) control of matrix volume fraction, primarily through control of matrix coating thickness, (d) control over chemistry and homogeneity of the deposited matrix, (e) uniform fiber distribution, (f) lower processing temperatures, and (g) flexibility in fiber-matrix interface control/design. The specific objectives of the Phase I effort are: (1) to demonstrate the potential of the sputter deposition process for obtaining highly controlled, uniform, adherent deposits of the titanium aluminide alloy, Ti-22Al-23Nb, on short-length SiC fibers, (2) to demonstrate the feasibility of obtaining MMC's by consolidation of the matrix-containing fibers, (3) to demonstrate proof-of-concept through microstructural studies, thermal cycling and room temperature tensile tests on the fabricated MMC's, (4) to develop a conceptual and engineering design of a reel-to-reel coating system for deposition of matrix alloys on continuous fibers, and (5) provide a comparative cost analysis of the proposed technique in relation to conventional MMC manufacturing processes.

UES, INC.
4401 DAYTON-XENIA ROAD
DAYTON, OH 45432

Topic#: 93-144 ID#: 93WL5-330
Office: WL5
Contract #: F33615-93-C-5343

147

Phone: (513) 426-6900 PI: Dr Rabi S Bhattacharya
Title: Sol-gel Deposition of Coatings on Aluminum Alloys for Adhesive Bonding
Abstract: The objective of this proposal is to develop surface preparation method for aircraft grade aluminum alloys for adhesive bonding using sol-gel processes. Low temperature phase y-Al2-O3 coatings will be prepared on aluminum alloys by sol-gel processing. The problem of drying and sintering of gels on aluminum alloys will be solved by rapid thermal processing (RTP). RTP involves high temperature (1000-1200 degrees C) exposure for a very short (5-20 sec) period of time, so that the substrate temperature may not exceed the thermal limit of processing aluminum alloys. The Phase I goal is to demonstrate the process feasibility by depositing anhydrous alumina coatings. The coatings will be characterized for chemical composition, morphology, thermodynamic stability, hydrolytic stability and bondability.

UES, INC. Topic#: 93-158 ID#: 93XRX-123
4401 DAYTON-XENIA ROAD Office: XRX
DAYTON, OH 45432 Contract #: F33657-93-C-2271
Phone: (513) 426-6900 PI: Dr. Rabi S. Bhattacharya
Title: Improved Threaded Fastener Coatings for Turbine Engine Applications
Abstract: Threaded fasteners used in turbine engine experience seizing/galling problems due to exposure at high temperature, corrosive environment and vibration. A research program is proposed that includes determination of the mode of failure of the currently used fastener-coating systems, and evaluation of novel coating materials and processes under simulated service conditions. A preliminary selection of coating materials based on the experience of an engine manufacturer is proposed. Initial screening of proposed coating materials will be conducted by using sputtered coatings. Other less-sophisticated methods will be investigated for coatings selected from sputtering experiments. The coated fasteners will be assembled and exposed to high temperature and vibration using the existing test facilities at Pratt and Whitney. A realistic screening test incorporating the environmental engine condition of temperature and vibration will be developed in Phase I in collaboration with Pratt and Whitney.

ULTRAMET Topic#: 93-094 ID#: 93PL3-013
12173 MONTAGUE STREET Office: PL3
PACOIMA, CA 91331 Contract #: FO4611-93-C-0088
Phone: (818) 899-0236 PI: Robert H. Tuffias, PhD
Title: Materials for Next-generation Rocket Engines
Abstract: Iridium/Rhenium (Ir/Re) technology developed at Ultramet has demonstrated the ability of liquid rocket engines to operate above 2200C for tens of hours. 22-N (5-lbf) and 445-N (100-lbf) units have been built and tested, and have demonstrated an improvement in specific impulse (Isp) of some 20 seconds, which translates into a productivity increase of 5-10%. Similar resul's could be achieved if this technology could be transferred to large and/or new technology engines, such as electric propulsion. The key problem is weight, as the structural material, rhenium, has a density of 21 g/cm3 and 44.5-kN (10,000-lbf) engine made of solid rhenium would weigh some 200 kg, which is unacceptably high. In this Phase I program, Ultramet proposes to demonstrate the feasibility of fabricating large Ir/Re rocket engines that exhibit the same performance as the previously demonstrated small engines but with no weight penalty, through the application of bold and innovative materials science to the development of unique composite structures such that further advances can be made in this area of technology.

ULTRAMET Topic#: 93-096 ID#: 93PL3-034
12173 MONTAGUE STREET Office: PL3
PACOIMA, CA 91331 Contract #: FO4611-93-C-0096
Phone: (818) 899-0236 PI: Robert H. Tuffias, PhD
Title: Noble Metal Coatings for Increased Turbopump Rotor Temperature and Life
Abstract: Current superalloy turbopump rotor materials are limited in both maximum use temperature and environmental stability. Extended use at elevated temperatures leads to stress corrosion cracking, followed by turbine blade separation. Ultramet previously fabricated an iridium coating on a forged Astroloy Mk-51 turbopump turbine rotor by chemical vapor deposition (CVD). Iridium was selected as the coating material for two reasons. First, its high temperature environmental stability has been demonstrated in test-firing of iridium-lined rhenium thrust chambers at temperatures above 4000F for more

150

than 15 hours without failure. Second, iridium can be applied by CVD at ~900F, low enough that the coating process will not affect the condition of the forging or cause dimensional changes. Even though the turbine disk had been tested previously and was severely work hardened, the iridium-coated rotor survived 10 starts totaling 4,106 seconds of hot-fire time at 60,000-65,000 rpm with only isolated areas of coating failure, which were attributed to the external work hardening of the rotor surface during fabrication by the manufacturer and/or a coating/substrate thermal expansion mismatch. In this Phase I program, Ultramet proposes to apply innovative materials and processing to turbopump protection. By expanding the materials studied to include iridium, platinum, and palladium and developing new processing techniques, success is virtually ensured. Each material offers outstanding high temperature environmental stability, with the latter two possibly providing better mechanical integrity due to a closer CTE match.

UNIVERSITY RESEARCH ENGRS & ASSOC., INC.
BLDG 10, SUITE 5, OAK RIDGE DRIVE
MAYNARD, MA 01754
Phone: (508) 897-0684

Topic#: 93-023
Office: AL
Contract #: F41624-93-C-2001
PI: Matthew C Callahan, MD

ID#: 93AL -101

Title: Auscultation of Patient Breath Sounds During Patient Aeromedical Evacuation

Abstract: Auscultation of breath sounds during an aeromedical evacuation is unachievable because of the noisy environment. Thus patient care capability is diminished because diagnosis and timely intervention might be compromised. In an emergency situation, civil or military, the traditional ambulance and aircraft (helicopter & fixed wing) are the usual means of evacuating critically ill patients. While the enclosed clinical space of these vehicles is noisy, the helicopter cabin noise is usually loudest. Helicopter noise levels of 100 dB(A) are common while breath sounds (signals) have been measured at 30 dB(A) and frequency ranges are comparable. Improving auscultation in this environment presents unique and complex problems which require unique solutions. The R&D effort demands a comprehensive investigation and understanding of the: (1) auscultation & diagnostic requirements, i.e., patient sound pathology (signals), (2) signal characteristics (frequency, amplitude), (3) noise interference characteristics, (4) method(s) for transmitting signals to the medic with maximum fidelity. The principal Phase I objective is the design and demonstration of a bread-board model of the Auscultation Sensor & Telemetry Device (ASTD) in a simulated aeromedical evacuation environment (110 dB(A) noise level). Active & passive noise reduction technologies will be integrated into the design as necessary. UREA established alliances with consultants and companies that could best provide additional program support and diminish R&D risks.

UNIVERSITY RESEARCH ENGRS & ASSOC., INC.
BLDG 10, SUITE 5, OAK RIDGE DRIVE
MAYNARD, MA 01754
Phone: (508) 897-0684

Topic#: 93-103
Office: PL6
Contract #: F04704-93-C-0003
PI: Kenneth N. Astill

ID#: 93PL6-040

Title: Closed Cycle, Closed Loop Multi-functional Cleaning Machine

Abstract: The United States, a signatory to the 1987 Montreal Protocol (4), is committed to reducing/eliminating the release of stratospheric ozone layer depleting substances (OLDS) to the atmosphere. The phaseout deadline for such substances, e.g., trichlorotrifluoroethane (CFC-113) and 1,1,1,-trichlorethane (TRIC) is 31 Dec 1995. Peacekeeper reliability is vital and performance can be diminished by dirt/grease on strategic inertial guidance system components. TRIC & CFC-113 are used extensively by USAF, USN & USA to clean vital components. Thus, there is a need, throughout the DoD, for a multi-functional cleaning system that will enable the cost effective use of new (very expensive) CFC replacement solvents and also permit the use of stockpiled OLDS in an environmental acceptable manner. UREA's innovative adaptation of the USAF multi-functional cleaning machine focuses on the integration of basic functions into a viable system, i.e., (1) enclosed (air tight) solvent cleaning process, (2) cleaning medium recycle/recondition loop, (3) component handling, and (4) monitor & control. Inlet/outlet "Air-Lock Chambers" and material handling will assure that the system's internal atmosphere will be maintained and guarantee zero gas/vapor out-flow. UREA also proposes to integrate SBIR sponsored emerging technology developments, as required. Selected demonstrations will be conducted during Phase I to confirm concept feasibility, particularly the cleaning chamber's internal atmosphere and ultrasonic transducer enhancements.

UTD, INC.
8560 CINDERBED RD, SUITE 1300
NEWINGTON, VA 22122
Phone: (703) 339-0800

Topic#: 92-095 ID#: 92PL6-023
Office: BMO/MYSP
Contract #: F04704-93-C-0018
PI: EUGENE L. FOSTER

Title: "An Innovative Design Tool for Rapid Battle Scenario Assessment" (P-9156)

Abstract: A personal computer based program development for rapid performance assessment of underground basing concepts under varying battle scenarios is proposed. The program will provide direct input into establishing design criteria and conducting performance analysis of "high survivable" silo design concepts through the utilization of closed form equations whereas current methods employ time and cost intensive numerical approaches. UTD Incorporated has developed a suite of closed form equations which promises to expedite the analysis process. These equations have been applied to pre-existing experimental data sets and in fact appear to have improved accuracy compared with other currently used methods. The equations provide ground shockwave characteristics such as peak pressure, velocity, rate of decay, etc., given yield value, material parameters and distance from the working point. The program will provide assessment of air, surface and underground bursts, cratering and ejecta predictions, shockwave characteristics and silo survivability. The Phase I effort consists of compiling critical calculation elements for assessing nuclear shock, cratering and ejecta parameters and their influence on missile basing. Refinement and development needs will be identified and initiated. Programming will be initiated to provide limited analysis capability within the Phase I effort. Phase II will produce a finalized program including validation.

VIGYAN, INC.
30 RESEARCH DR
HAMPTON, VA 23666
Phone: (804) 865-1400

Topic#: 93-130 ID#: 93WL4-040
Office: WL4
Contract #: F33615-93-C-3004
PI: Dhanvada M. Rao

Title: Active Flow-control Concepts for Stall Alleviation and Post-stall Lift Improvement of Vortex Dominated Fighter Configuration

Abstract: It is proposed to experimentally explore two active separation-control concepts aimed at stall alleviation and maximum-lift improvement on generic, vortex-dominated fighter configurations. The concepts comprise a delta wing incorporating transversely-hinged apex flaps oscillating in the pitch plane, and a LEX-trapezoidal wing combination with root-hinged LEX's oscillating in the cross-plane. The common purpose of the active devices is to establish a hysteresis loop with average lift higher than the undisturbed wing lift at the same angle of attack. Even if the wing flow-field moves in and out of stall, it is anticipated that the time-averaged lift will be considerably improved. Low-speed wind tunnel tests will be conducted on two wing-body models in a wide range of angle of attack and with varying control surface frequency and amplitude parameters, measuring time-averaged six-component aerodynamic coefficients, wing surface pressures and near-wake velocity components, to determine the feasibility of the active devices and quantify their effectiveness. The potential of non-symmetrical activation of the devices for lateral control near stall will also be explored.

VISIDYNE, INC.
10 CORPORATE PLACE, SOUTH BEDFORD STREET
BURLINGTON, MA 01803
Phone: (617) 273-2820

Topic#: 93-099 ID#: 93PL4-034
Office: PL4
Contract #: F19628-93-C-0071
PI: Orr Shepherd

Title: Ion Composition Detection in High Temperature Plasma

Abstract: As the USAF works towards extending the performance envelope of its modern high performance aircraft and advanced re-entry vehicles, it is beginning to encounter multiple problems created by the presence of high temperature plasmas. The source of the plasma may vary from a jet or rocket engine plume to the sheath and wake plasmas caused during the re-entry of hypervelocity vehicle; however, understanding the nature of these plasmas, their effect on Air Force weapons systems, and the development of methods to alleviate any detrimental effects of these plasmas will depend upon our ability to accurately measure the chemical kinetics that define the plasmas properties. Given the current state-of-the-art in plasma diagnostics, the quadrupole mass spectrometer, properly designed for high-temperature, high-velocity plasma flow measurements is an ideal candidate for this task. Given the stressing environment, the technical problems are formidable. Great emphasis will be placed upon design of the inlet nozzle, its effect on the flow of the plasma and its ability to avoid disturbing the chemical structure of the stream during the sampling process. The goal of this research is to design a rugged, versatile mass spectrometer system that achieves accurate reproducible measurements of the ion population of high temperature plasmas.

(152)

VISIDYNE, INC.
10 CORPORATE PLACE, SOUTH BEDFORD STREET
BURLINGTON, MA 01803
Phone: (617) 273-2820
Topic#: 93-35A ID#: 93PL4-094
Office: PL4
Contract #: F19628-93-C-0184
PI: Robert A. Skrivanek
Title: Feasibility Study of New Methods for C3I and Surveillance Using Ionospheric Modification
Abstract: This exploratory development is directed toward finding new methods of using artificially modified ionospheric regions for extending and enhancing communication (C3I) and surveillance (radar) capabilities. Specifically, the investigation, starting with a Phase I feasibility and planning effort and leading to a Phase II field experimental/demonstration effort, is to use existing active OTH radars to detect backscattering from ionospheric irregularities generated by HF ionospheric heating facilities. This is to be followed with experimental communication paths constructed with geometries to scatter via the heated volume irregularities, thus providing a new means of connectivity or communication between distant points. Over-the-horizon radars located in Alaska or near the East Coast of the U.S. will be considered for use together with ionospheric heating facilities also located in Alaska and Puerto Rico, respectively to analyze and provide the best experimental plan. The Phase II program will use the selected geometries, together with appropriate diagnostics to provide a demonstration of the capabilities.

VOSS SCIENTIFIC
416 WASHINGTON ST. SE
ALBUQUERQUE, NM 87108
Phone: (505) 255-4201
Topic#: 93-074 ID#: 93PL1-230
Office: PL1
Contract #: F29601-93-C-0044
PI: DONALD E. VOSS, Ph.D.
Title: High Current Cathodes Without A-K Gap Closure
Abstract: Development of high power microwave (HPM) sources for Air Force applications requires cathodes with long usable lifetimes, negligible anode-cathode (A-K) gap closure, reproducible functioning under high repetition pulsing, uniform current density, and negligible plasma/current production from nearby surfaces. Cathodes must maintain such stable electron beam output characteristics for > 1 nsec. We propose to meet these requirements in an extremely low cost, robust carbon cathode with a matrix of carbon fiber tufts as the emitting surface. Innovations to improve performance include: cesium iodide coating to reduce plasma gap closure and improve current density uniformity; an intermediate electrode to reduce unwanted plasma production from nearby surfaces and increase total current; increased carbon tuft surface density to produce more uniform current density and reduce explosive plasma production; and a ballast resistor array behind the fibers to prevent hot spots of current/plasma production. Cathodes will be produced utilizing these novel features and tested on a crowbarred Marx for 1-2 nsec pulses. Using a corona bushing to eliminate edge effects, 5-cm radius cathodes will be tested with 4-cm A-K gaps up to the 150-200 kV range. Gap closure rates, current density uniformity, and field stress applied to cathode will be determined, and configuration optimized for meeting target performance goals.

WADDAN SYSTEMS
8801 ENCINO AVENUE
NORTHRIDGE, CA 91325
Phone: (805) 257-4172
Topic#: 93-164 ID#: 93WL0-244
Office: WL0
Contract #: F08630-93-C-0022
PI: DR. MAHENDRA SINGH
Title: Low Cost Guidance Systems
Abstract: Development of an Inertia Measuring Unit (IMD) to be packaged in a strap-down Inertial Navigation System (INS) is proposed. The IMU design is based upon the silicon accelerometers developed by Waddan Systems. A pair of these devices, mounted on inclined webs in a hollow cylindrical rotor with their input axes pointing in the diametrically opposite directions at an angle, can be employed to determine the linear acceleration component along their common input axis by taking the average of their outputs. The same pair can also be employed to extract the angular rate component lying in a plane perpendicular to their common input axis by taking the difference in their outputs; which are affected equally but in opposite directions by the curialis acceleration caused by the angular rate component. The development of an IMU design based upon this concept is the objective of the Phase I effort.

WAMAX, INC.
4473 142ND AVE SE
BELLEVUE, WA 98006
Topic#: 93-118 ID#: 93WL3-012
Office: WL3
Contract #: F33615-93-C-1259

153

Phone: (206) 643-4755 PI: Dr. Rong Wang
Title: High Temperature Metal Ceramic Packing
Abstract: Strong, durable and vacuum tight seals between SiC or diamond films and copper and other materials are needed for high density packaging/interconnect applications. Presently, there are many problems in joining these very dissimilar materials to form reliable and strong bonds. Most of these problems are related to large differences in their melting temperatures and with non-adherent oxides of the metals. For high-temperature applications, problems in the mismatch of their thermal expansion coefficients would also be quite serious. This proposed research will develop novel surface processes to address these problems, especially to reduce dynamic stresses generated during temperature fluctuations. Phase I will demonstrate and test the thermal stability and strength of joints made of SiC and diamond films to copper. Phase II will involve optimization of the processes in terms of uniformity, reliability, durability and cost effectiveness. Phase III will develop potential applications of electronic packaging in manufacturing and specific applications.

WEINSCHEL ASSOC. Topic#: 93-046 ID#: 93ES3-067
42 CESSNA COUET (CAGE OH3E9) Office: ES3
GAITHERSBURG, MD 20879 Contract #: F19628-93-C-0124
Phone: (301) 948-8342 PI: BRUNO O. WEINSCHEL
Title: 60 GHz Coaxial Components
Abstract: This is a feasibility study for a single pole, double throw, mechanical switch, using 1.85 mm coaxial connectors complying with the proposed connector standard in document IEC 46D (USA) 145. One major problem is the theoretical optimization of the two transitions from the 1.85 mm input coaxial airline to the switching reed which is a one mil thick, flat leaf spring and back to the 1.85 mm output coaxial airline. The machining and testing will be facilitated by scaling the line size up and the frequency down by a factor of 3.78. The concept will be proven and optimized by measurements in a 7 mm airline to 18 GHz. Then it will be constructed in a 1.85 mm line and tested to 65 GHz. Another major effort will be a theoretical stress study of the optimum reed shape to produce a minimum life of one million steps. In Phase 2, a goal of 5 million steps should be considered. A manual switch will be furnished as a deliverable with all S parameters tested to 65 GHz on a Wiltron model 360 Network Analyzer. An electrically actuated switch, magnetically latched, with current disconnect, should be considered in Phase 2.

WEST COAST REPS, INC. Topic#: 93-131 ID#: 93WL4-010
1200 LLANO Office: WL4
SAN CLEMENTE, CA 92673 Contract #: F33615-93-C-3802
Phone: (714) 492-8670 PI: Greg Shuff
Title: Facilitating Accident Evaluations of Aircraft with "Glass" Cockpits
Abstract: Today's military aircraft are outfitted with "Glass" cockpit displays almost exclusively, including CRT, flat panel, heads up and helmet mounted displays. Unfortunately, in the event of aircraft accidents, there is no indication of display status the way there might be with mechanical gauges (jammed gears, heat imprints of dial indicators, etc.) A device which would record the display readout upon impact would be of considerable assistance to investigators, and a device or Display Crash Recorder (DCR) which would record several minutes of display imagery prior to impact would be invaluable. Investigators could precisely recreate display scenarios and visualize what pilots had observed leading up to and immediately prior to accidents. This capability could give investigators the insight as to possible causes, allowing them to be more specific as to their accident investigation procedures. Phase I will validate the concept, provide the investigation and analysis necessary to develop and deliver a working prototype and simulation platform to demonstrate feasibility. Phase II will utilize equipment developed in Phase I for further software/algorithm development and produce a first article production prototype along with documentation and drawings sufficient for Phase III production.

WINTEC, INC. Topic#: 93-164 ID#: 93WL0-243
220 EGLIN PARKWAY, S.E. Office: WL0
FORT WALTON BEACH, FL 32548 Contract #: F08630-93-C-0120
Phone: (904) 664-6203 PI: Fred L. Benedick
Title: Advanced Avionics Support for Ground Based Munitions Testing

154

Abstract: With the high cost of flight testing advanced munitions in an increasingly austere budget environment, significant effort is being devoted to developing ground based alternatives to augment actual flight testing. For maximum realism, the capability is required to test the munitions and their carrying aircraft as an integrated system in a simulated target/threat environment. A current effort is underway at Eglin AFB to connect the Preflight Integration of Munitions and Electronic Systems (PRIMES) facility and Guided Weapon Evaluation Facility (GWEF) via a fiber optic link, to provide such an integrated capability for certain current generation aircraft. While the current GWEF/PRIMES development activities may provide some level of current generation stores management and avionics simulation capability, next generation delivery platforms will be based on the highly integrated and modular advanced avionics concepts reflected by the Pave Pillar advanced avionics architecture and associated Joint Integrated Avionics Working Group (JIAWG) standardization activities. To ensure a continued integrated test capability as these advanced platforms evolve, the effort proposed here would define a compatible advanced avionics support capability for munitions testing and a recommended approach to its realization.

XONTECH, INC.
6862 HAYVENHURST AVENUE
VAN NUYS, CA 91406
Phone: (310) 649-3477

Topic#: 93-105 ID#: 93PL6-019
Office: PL6
Contract #: F04704-93-C-0011
PI: Stanley G. Howard

Title: Methods of Reducing Reentry Plasma Effects for Advanced Systems

Abstract: This proposed study will examine methods for reducing deleterious effects of the plasma on electromagnetic (EM) transmissions from future hypersonic reentry vehicles (RV's). Among the many techniques suggested for this purpose are material selection, vehicle shaping, antenna location, EM frequency selection, flowfield cooling, electron recombination/attachment, and magnetic windows. Many of these techniques are examined from time to time in the light of recent technological advances and unique aspects of potential future missions. A particularly intriguing technique with the advent of so-called high temperature superconductors is the magnetic window. If a high intensity, static magnetic field can be sustained over the antenna, the free electrons may be "immobilized", thereby permitting uninterrupted transmission. This study examines the magnetic window in the light of superconducting materials, more sophisticated plasma attenuation calculations, and future missions. The results of this study will include realistic estimates of system weight, especially as it is affected by aperture size and field inhomogeneities.

(155) 56

157

161

F

165

G

J

K

160

P

150

AF Topic#: 92-020
CAMBRIDGE ACOUSTICAL ASSOC., INC.

AF Topic#: 92-031
LOGOS, INC.

AF Topic#: 92-095
UTD, INC.

AF Topic#: 92-153
ELECTRONIC SOLUTIONS CORP.

AF Topic#: 93-001
AEROMETRICS, INC.
INSITEC, INC.

AF Topic#: 93-002
AEROMETRICS, INC.
METROLASER

AF Topic#: 93-003
OPTI-LOGIC CORP.
QUEST INTEGRATED, INC.

AF Topic#: 93-004
FLUIDYNE ENGINEERING CORP.
MATERIALS & SYSTEMS RESEARCH, INC.

AF Topic#: 93-005
CANDELA LASER CORP.
PHYSICAL SCIENCES, INC.

AF Topic#: 93-006
ARROW TECH ASSOC., INC.
QUEST INTEGRATED, INC.

AF Topic#: 93-007
EIC LABORATORIES, INC.
FOSTER-MILLER, INC.

AF Topic#: 93-008
ENVIRONMENTAL BIOTECHNOLOGIES, INC.

AF Topic#: 93-009
DYNAX CORP.
HUGHES ASSOC., INC.
MAINSTREAM ENGINEERING CORP.

AF Topic#: 93-010
ASPEN SYSTEMS, INC.
ENGINEERING RESOURCES, INC.

AF Topic#: 93-011
ADA TECHNOLOGIES, INC.
ADA TECHNOLOGIES, INC.
ADHERENT TECHNOLOGIES
BELTRAN, INC.
BERKELEY MICROINSTRUMENTS
CAPE COD RESEARCH, INC.
D. C. RICH COMPANY
DONALD J. GEISEL & ASSOC., INC.
DRAGAN ENGINEERING
ECODYNAMICS RESEARCH ASSOC., INC.
FOSTER-MILLER, INC.
FTC ACQUISITION CORP.
H.V. SETTY ENTERPRISES, INC.
IGR ENTERPRISES, INC.
KENTERPRICE RESEARCH, INC.
KSE, INC.
MAINE RESEARCH & TECHNOLOGY
MEMBRANE TECHNOLOGY & RESEARCH, INC.
MEMBRANE TECHNOLOGY & RESEARCH, INC.
MIMS TECHNOLOGY DEVELOPMENT COMPANY
SCIENCE RESEARCH LABORATORY, INC.
SORBENT TECHNOLOGIES CORP.

AF Topic#: 93-012
APPLIED ENGINEERING TECHNOLOGIES, LTD.
MICROPUMP CORP.
MORGAN RESEARCH CORP.

AF Topic#: 93-013
CHARLES WILLIS & ASSOC., INC.
DECISION DYNAMICS, INC.

AF Topic#: 93-014
PACIFIC RIM ENGINEERING

AF Topic#: 93-015
BERKELEY APPLIED SCIENCE & ENGINEER
C & C TECHNOLOGIES, INC.
CSA ENGINEERING, INC.
FIBER & SENSOR TECHNOLOGIES, INC.
MSNW, INC.

AF Topic#: 93-016
DISPLAYTECH, INC.
FOSTER-MILLER, INC.
LASER PHONOTICS TECHNOLOGY, INC.
MOLECULAR TECHNOLOGIES, INC.
TACAN CORP.

AF Topic#: 93-017
BARRON ASSOC., INC.
CHARLES RIVER ANALYTICS, INC.

AF Topic#: 93-018
APA OPTICS, INC.
NZ APPLIED TECHNOLOGIES

AF Topic#: 93-019
PD-LD, INC.
SUPERIOR VACUUM TECHNOLOGY, INC.

AF Topic#: 93-020
SPIRE CORP.

AF Topic#: 93-021
CRYSTAL SYSTEMS, INC.
CRYSTALLUME
SCIENTIFIC MATERIALS CORP.

AF Topic#: 93-022
QUANTUM MAGNETICS, INC.
SQM TECHNOLOGY, INC.

AF Topic#: 93-023
APPLIED SCIENCE LABORATORIES
BIODYNAMIC RESEARCH CORP.
BIOMEDICAL ENTERPRISES, INC.
CONCEPTUAL MINDWORKS, INC.
DAVID DUBBINK ASSOC.
ENGINEERED MEDICAL SYSTEMS, INC.
ENGINEERED MEDICAL SYSTEMS, INC.
FEMTOSCAN CORP.
FORWARD VISION
INNER HEALTH, INC.
KNOWLEDGE BASED SYSTEMS, INC.
LME, INC.
MAN-MADE SYSTEMS CORP.
OPERATIONAL TECHNOLOGIES CORP.
OPERATIONAL TECHNOLOGIES CORP.
QUANTUM MAGNETICS, INC.
ROSE IMAGING
SPECIALTY DEVICES, INC.
UNIVERSITY RESEARCH ENGRS & ASSOC., INC.

AF Topic#: 93-024
BIODYNAMIC RESEARCH CORP.

AF Topic#: 93-026
EXOS, INC.
SCIENCE & ENGINEERING ASSOC., INC.
TANNER RESEARCH, INC.

AF Topic#: 93-027
CREATIVE OPTICS, INC.
NIGHT VISION CORP.

AF Topic#: 93-029
GALAXY SCIENTIFIC CORP.
THE PLS GROUP

AF Topic#: 93-030
ESSEX CORP.
PERSONNEL DECISIONS RSCH INSTITUTE

AF Topic#: 93-031
FOSTER-MILLER, INC.

AF Topic#: 93-033
HARRIS MILLER MILLER & HANSON, INC.

AF Topic#: 93-034
APPLIED PHYSICS TECHNOLOGIES CORP.
AUTOMATED INSTRUMENTS

AF Topic#: 93-035
ATLANTIC AEROSPACE ELECTRONICS CORP.
FALCON COMMUNICATIONS CORP.
INFRARED COMPONENTS CORP.
LASERTRON, INC.
OPTICOMP CORP.
PHYSICAL OPTICS CORP.
SCIENTIFIC STUDIES CORP.
SYNECTICS CORP.
THE ULTRA CORP.
TRIFID CORP.

AF Topic#: 93-036
DYNAMIC SYSTEMS, INC.
PHYSICAL OPTICS CORP.

AF Topic#: 93-037
AES CORP.
MIKOS LTD.
NIAGARA TECHNOLOGY LABORATORIES
NOVA ENGINEERING, INC.

AF Topic#: 93-038
HORINE ENGINEERS, INC.

AF Topic#: 93-039
BREWER ASSOC., INC.
SIX SIGMA ANALYTICS

AF Topic#: 93-040
DECISION SCIENCE ASSOC., INC.
KNOWLEDGE BASED SYSTEMS, INC.

AF Topic#: 93-041
ALPHATECH, INC.

AF Topic#: 93-071
MERIT TECHNOLOGY, INC.
RETICULAR SYSTEMS, INC.

AF Topic#: 93-072
ADVANCEDREFRACTORYTECHNOLOGIES,INC.
SPIRE CORP.

AF Topic#: 93-073
ACCURATE AUTOMATION CORP.
APPLIED SCIENCES LABORATORY, INC.

AF Topic#: 93-074
INTEGRATED APPLIED PHYSICS, INC.
VOSS SCIENTIFIC

AF Topic#: 93-075
DANIEL H. WAGNER ASSOC., INC.
FAIRFAX MATERIALS RESEARCH, INC.

AF Topic#: 93-076
HYPRES, INC.
OPTRA, INC.

AF Topic#: 93-077
FARR RESEARCH
KTECH CORP.
SCIENCE & ENGINEERING ASSOC., INC.
SHIELD RITE, INC.

AF Topic#: 93-079
APPLIED OPTRONICS CORP.
SENSORS UNLIMITED, INC.
SPECTRA DIODE LABORATORIES, INC.

AF Topic#: 93-080
FERMIONICS CORP.
SPIRE CORP.

AF Topic#: 93-081
LEXITEK
RGB ASSOC., INC.
TECHNOLOGY RESEARCH ASSOC.

AF Topic#: 93-082
ADVANCED TECHNOLOGY MATERIALS, INC.
CAMBRIDGE RESEARCH & INSTRUMENTATION
SPIRE CORP.

AF Topic#: 93-083
APPLIED TECHNOLOGY ASSOC., INC.
G.A.TYLER ASSOC., INC.

AF Topic#: 93-084
CYGNUS LASER CORP.
LASER POWER CORP.
SPECTRA DIODE LABORATORIES, INC.

AF Topic#: 93-085
PHYSICAL SCIENCES, INC.
STI OPTRONICS, INC.

AF Topic#: 93-086
MICROCOSM, INC.
PHD RESEARCH GROUP, INC.
SADDLEBACK AEROSPACE

AF Topic#: 93-087
ELECTRO OPTIC CONSULTING SERVICES
INNOVATION ASSOC., INC.
PHYSICAL OPTICS CORP.
SY TECHNOLOGY, INC.

AF Topic#: 93-088
APPLIED OPTRONICS CORP.
LASER DATA TECHNOLOGY, INC.
LIGHTWAVE ELECTRONICS CORP.
RAMAR CORP.
SPECTRA DIODE LABORATORIES, INC.
SPECTRA DIODE LABORATORIES, INC.
SPIRE CORP.
SRICO, INC.

AF Topic#: 93-089
MICROCOSM, INC.
SYSTEMS CONTROL TECHNOLOGY, INC.

AF Topic#: 93-090
BUSEK CO., INC.
ELECTRIC PROPULSION LABORATORY, INC.
SPECTRA-METRICS CORP.

AF Topic#: 93-091
P. NICHOLAS LAWRENCE
STEROIDS, LTD.
TPL, INC.

AF Topic#: 93-092
APD CRYOGENICS, INC.
CRYOGENIC ENGINEERING LABORATORY
ORBITAL TECHNOLOGIES CORP.
THOUGHTVENTIONS, INC.

AF Topic#: 93-093
ROCKFORD TECHNOLOGY ASSOC., INC.

AF Topic#: 93-094
AMITA
ELECTRIC PROPULSION LABORATORY, INC.
SCHAEFFER INDUSTRIES
ULTRAMET

AF Topic#: 93-095
FTC ACQUISITION CORP.
MAINSTREAM ENGINEERING CORP.

AF Topic#: 93-096
ENERGY SCIENCE LABORATORIES, INC.
SCHAEFFER INDUSTRIES
TECHNICAL RESEARCH ASSOC., INC.
THERMACORE, INC.
ULTRAMET

AF Topic#: 93-097
ATMOS & ENVIRONMENTAL RESEARCH, INC.
PHOTOMETRICS, INC.

AF Topic#: 93-098
GPS SOLUTIONS
LINCOM CORP.

AF Topic#: 93-099
METROLASER
VISIDYNE, INC.

AF Topic#: 93-100
NIELSEN ENGINEERING & RESEARCH, INC.

AF Topic#: 93-101
PRINCETON SCIENTIFIC INSTRUMENTS, INC.

AF Topic#: 93-102
PACIFIC-SIERRA RESEARCH CORP.
SECA, INC.

AF Topic#: 93-103
CF TECHNOLOGIES, INC.
UNIVERSITY RESEARCH ENGRS & ASSOC., INC.

AF Topic#: 93-104
AIREX CORP.
CREARE, INC.
M.S. SAPUPPO & ASSOC.

AF Topic#: 93-105
GENERAL SCIENCES, INC.
HYPERSONICS, INC.
HYPERSONICS, INC.
METROLASER
XONTECH, INC.

AF Topic#: 93-106
AMERICAN GNC CORP.
MARYLAND TECHNOLOGY CORP.
OPTICAL ETC, INC.
OPTITRONICS
RADIX TECHNOLOGIES, INC.
TOP-VU TECHNOLOGY, INC.

AF Topic#: 93-107
RADIX TECHNOLOGIES, INC.

AF Topic#: 93-108
ABTECH CORP.
ACCURATE AUTOMATION CORP.

AF Topic#: 93-109
OPTIMIZATION TECHNOLOGY, INC.
SYMVIONICS, INC.

AF Topic#: 93-110
GMF, INC.
STATISTICAL SIGNAL PROCESSING, INC.

AF Topic#: 93-111
AMHERST SYSTEMS, INC.
MTL SYSTEMS, INC.

AF Topic#: 93-112
RADIAN TECHNOLOGY, INC.
S.T. RESEARCH CORP.

AF Topic#: 93-113
HYPRES, INC.
SIERRA MONOLITHICS, INC.

AF Topic#: 93-114
AMERICAN GNC CORP.
INTEGRATED SENSORS, INC.
SYNETICS CORP.

AF Topic#: 93-115
FRONTIER TECHNOLOGY, INC.
TECHNOLOGY SERVICE CORP.

AF Topic#: 93-116
AMHERST SYSTEMS, INC.
CYBERDYNAMICS, INC.
DEMACO
TECHNOLOGY SERVICE CORP.

FOSTER-MILLER, INC.
UES, INC.

AF Topic#: 93-145
CAPE COD RESEARCH, INC.
SUNREZ CORP.

AF Topic#: 93-146
MAGNA PHYSICS DIV OF TRIDELTA IND
THERMACORE, INC.

AF Topic#: 93-147
CREARE, INC.

AF Topic#: 93-148
CAPE COD RESEARCH, INC.
COVALENT ASSOC., INC.
LITHIUM ENERGY ASSOC., INC.

AF Topic#: 93-149
APPLIED SCIENCE & TECHNOLOGY, INC.

AF Topic#: 93-150
AEROSOFT, INC.

AF Topic#: 93-151
CERAMIC COMPOSITES, INC.
CFD RESEARCH CORP.
CFD RESEARCH CORP.
TDA RESEARCH, INC.

AF Topic#: 93-152
TAITECH, INC.

AF Topic#: 93-153
ADTECH SYSTEMS RESEARCH, INC.
CERAMIC COMPOSITES, INC.
JET PROCESS CORP.

AF Topic#: 93-154
NEURODYNE, INC.

AF Topic#: 93-155
ADVANCED FUEL RESEARCH, INC.

AF Topic#: 93-156
AMERICAN RESEARCH CORP. OF VIRGINIA
AVCON-ADVANCED CONTROLS TECH, INC.
PROTOS TECHNOLOGY, INC.

AF Topic#: 93-157
PHYSICAL SCIENCES, INC.
TDA RESEARCH, INC.

AF Topic#: 93-158
ACTIVE CONTROL EXPERTS, INC.
ADVANCED PROJECTS RESEARCH, INC.
AEROSPACE RECOVERY SYSTEMS, INC.
AMERICAN COMPUTATIONAL TECH SVC, INC.
CPU TECHNOLOGY, INC.
D-STAR ENGINEERING
MISSION RESEARCH CORP.
SPECTRA RESEARCH, INC.
SUMMATION, LTD.
SURFACES RESEARCH & APPLICATIONS, INC.
SYSTRAN CORP.
SYSTRAN CORP.
SYSTRAN CORP.
TECHNOSOFT, INC.
TOYON RESEARCH CORP.
UES, INC.

AF Topic#: 93-159
FRONTIER TECHNOLOGY, INC.

AF Topic#: 93-160
SYTRONICS, INC.

AF Topic#: 93-161
DECISION SCIENCE ASSOC., INC.
LYNNE GILFILLAN ASSOC., INC.
STR CORP.

AF Topic#: 93-162
ELECTRONIC DECISIONS, INC.
MISSION RESEARCH CORP.

AF Topic#: 93-163
ELECTROIMPACT, INC.
Q.R.D.C., INC.

AF Topic#: 93-164
ADVANCED PROJECTS RESEARCH, INC.
AMERICAN GNC CORP.
ANRO ENGINEERING, INC.
DYNA EAST CORP.
HUNTINGTON RESEARCH & ENGINEERING
MDA ENGINEERING, INC.
MILLITECH CORP.
NIELSEN ENGINEERING & RESERACH, INC.
NUCLEAR METALS, INC.
P. NICHOLAS LAWRENCE
RADIX TECHNOLOGIES, INC.
TANNER RESEARCH, INC.
WADDAN SYSTEMS
WINTEC, INC.